OIPE JC139
NOV 10 2004
PATENT & TRADEMARK OFFICE

RECEIVED
NOV 12 2004
Technology Center 2600

VERIFICATION OF TRANSLATION

I, Stewart Adamson, translator of To-shitsu, Fukujuso 2F, Tsukaguchi-Hommachi 4-5-13, Amagasaki City, Japan, hereby declare that I am conversant with the English and Japanese languages and am a competent translator thereof. I further declare that to the best of my knowledge and belief the following is a true and correct translation made by me of Japanese Patent Application H08-090891 filed on April 12, 1996.

Date: May 10, 2000

S Adamson

Stewart Adamson

[Title of the Document] Patent Application

[Reference Number] 2022580218

[Application Date] April 12, 1996

[Direction] Commissioner,
Patent Office

[Classification of International Patent] G11B 13/02

[Title of the Invention] MULTIMEDIA OPTICAL DISC, AND REPRODUCING DEVICE

[Number of claims] 8

[Inventor]

[Address or Residence] c/o MATSUSHITA ELECTRIC INDUSTRIAL Co., Ltd. 1006,Kadoma,Kadoma-shi, Osaka

[Name] Kazuhiko Yamauchi

[Inventor]

[Address or Residence] c/o MATSUSHITA ELECTRIC INDUSTRIAL Co., Ltd. 1006,Kadoma,Kadoma-shi, Osaka

[Name] Shin'ichi Saeki

[Inventor]

[Address or Residence] c/o MATSUSHITA ELECTRIC INDUSTRIAL Co., Ltd. 1006,Kadoma,Kadoma-shi, Osaka

[Name] Katsuhiko Miwa

[Inventor]

[Address or Residence] c/o MATSUSHITA ELECTRIC

INDUSTRIAL Co., Ltd.
1006,Kadoma,Kadoma-shi, Osaka

[Name] Masayuki Kozuka

[Inventor]

[Address or Residence] c/o MATSUSHITA ELECTRIC
INDUSTRIAL Co., Ltd.
1006,Kadoma,Kadoma-shi, Osaka

[Name] Kaoru Murase

[Applicant]

[Identification Number] 000005821

[Postal Code] 571

[Address] 1006,Kadoma,Kadoma-shi,Osaka

[Name] MATSUSHITA ELECTRIC
INDUSTRIAL Co., Ltd.

[Representative] Youichi Morishita

[Patent Attorney]

[Identification Number] 100078204

[Postal Code] 571

[Address or Residence] c/o MATSUSHITA ELECTRIC
INDUSTRIAL Co., Ltd.
1006,Kadoma,Kadoma-shi, Osaka

[Name] Tomoyuki Takimoto

[Patent Attorney]

[Identification Number] 100097445

[Postal Code] 571

[Address or Residence] c/o MATSUSHITA ELECTRIC INDUSTRIAL Co., Ltd. 1006,Kadoma,Kadoma-shi, Osaka

[Name] Fumio Iwabashi

[Method of Payment] Prepayment

[Prepayment Registration Number] 011305

[Filing Fee] ¥21000

[List of Enclosures]

[Document] Specification 1

[Document] Drawing 1

[Document] Abstract 1

[Power of Attorney/Reference No.] 9308195

[Document] Specification

Title of the Invention

Multimedia optical disc and reproduction apparatus

Range of the Patent Claims

1. An optical disc that has at least one information layer between a first and second transparent substrate which have an equal thickness of 0.6mm or below, characterized by including:

a system stream recording area for storing system streams which include at least video information and reproduction control commands; and

a reproduction control information recording area that stores:

a plurality of sets of system stream reproduction control information each expressing at least one system stream reproduction order and reproduction control commands to be automatically executed during reproduction;

first flag information showing characteristics of the title connection structure as management information for a title which is made up of one or more sets of system stream reproduction control information that are linked together during reproduction; and

second flag information showing characteristics of the reproduction control commands included in a title.

2. The multimedia optical disc of Claim 1,

wherein the first flag information stores a single sequential system stream control information flag showing that the title is composed of only one set of system stream control information and that the system streams indicated by the system stream control information are reproduced in order,

and wherein the second flag information stores a no automatic branch flag which indicates that the title does not include automatically executed commands which cause branches in the reproduction route.

3. The multimedia optical disc of Claim 1,

wherein the second flag information stores, in addition to the no automatic branch flag, a no inter-title branch flag which shows that a title does not include reproduction control commands which perform branches between titles during reproduction.

4. A reproduction apparatus which reproduces and outputs video and audio stored as information on an optical disc, the apparatus being provided with AV disc functions to be executed during reproduction when there is only one reproduction route, the apparatus comprising:

reproduction means for reproducing the optical disc of Claim 1 and for outputting system streams, sets of system

stream reproduction control information, and the first flag information and the second flag information which are the attribute information for a title;

first flag storage means for storing the first flag information for the title being reproduced;

second flag storage means for storing the second flag information for the title being reproduced;

input means for inputting external requests for the execution of AV disc functions;

function permission table storage means for storing a function permission table which shows pairings of the first and second flag information as execution permission conditions for the AV disc functions; and

control means for determining system streams to be reproduced in accordance with system stream reproduction control information and performing reproduction control, as well as judging, when the input means receives an external request for the execution of a AV disc function, whether the requested function is possible, based on the first and second flag information and the function permission table, before executing the received function only when it is permitted.

5. The reproduction apparatus of Claim 4,

wherein the AV disc functions include at least a feedback function, with the execution permission condition

for the feedback function in the execution permission table being the setting of both the single sequential PGC identification flag and the no automatic branch flag.

6. The reproduction apparatus of Claim 4,

wherein the AV disc functions include at least a search function, with the execution permission condition for the search function in the execution permission table being the setting of both the single sequential PGC identification flag and the no automatic branch flag.

7. The reproduction apparatus of Claim 4,

wherein the AV disc functions at least include a programming function and a title programming function, with the execution permission condition for the programming function in the execution permission table being the setting of both the single sequential PGC identification flag and the no automatic branch flag, and the execution permission condition for the title programming function in the execution permission table being the setting of both the single sequential PGC identification flag and no inter-title branch flag.

8. The reproduction apparatus of Claim 5, further comprising a state display unit which updates a displayed index number in accordance with the feedback function and which displays

a title number together with the index number.

Detailed Description of the Invention

[0001]

Industrial Field of Application

The present invention relates to a multimedia optical disc storing an information signal composed of audio information and video information, and to a reproduction apparatus for such disc.

[0002]

Related Art

Laser discs and Video CDs and their reproduction devices have been developed as optical information storage media and reproduction devices which can be used to record and playback audio information and moving picture information.

[0003]

Conventional laser disks achieve a playback time of around one hour using an optical disc which has a diameter of thirty centimeters, and are widely used as recording media for movies and music videos. However, when considering how unsuited these discs are to storage and portability, there is a demand for a more compact storage medium. As a result, video CDs (Compact Discs) have been developed for the recording and playback of video using a

high compression-rate digital data compression method called MPEG (Moving Pictures Experts Group) to record a large amount of moving picture data on what is a twelve-centimeter diameter disc that was originally developed for storing only audio data. However, as a downside of the compact size of video CDs, the moving picture output is limited to a resolution of 352 by 240 pixels, which is insufficient for movie applications that require high quality video.

[0004]

In recent years, Digital Video Discs (hereinafter, DVDs) have been proposed as a compact storage medium for high quality video.

[0005]

Moving picture data requires a far greater amount of data than audio data, with an even larger amount of data being required for high quality video. Because of this, the dual requirements of high storage capacity and compact size mean that it is necessary to increase the recording density of the disc. Here, this can obviously be achieved by reduced the size of the light spot used to read the disc, with this being possible either by increasing the numerical aperture of the objective lens or by reducing the wavelength of the laser used as the light beam. Here, if the wavelength of the laser is set as λ, and the numeric aperture is set as NA, the spot diameter D is proportionate to λ/NA.

[0006]

However, when a lens having a high NA value is used, such as described in USP 5,235,581, there is an increase in comatic aberration due to the relative inclination between the optical axis of the beam and the disc surface. The phenomenon is known as "tilt". To suppress tilt, it is necessary to reduce the thickness of the transparent substrate.

[0007]

Here, reductions in the thickness of the transparent substrate reduce the physical durability of the disc, so that it is effective to form the construction with a second reinforcing substrate.

[0008]

For the reasons given above, DVDs use a value of NA is increased from 0.45 used under the CD standard to 0.6, so that the spot diameter is reduced and a higher recording density is achieved. While conventional CDs use one 1.2mm thick transparent substrate, to physically reinforce the disc DVDs have two transparent substrates which are 0.6mm thick and which are bonded together with the information layer formed in between. By doing so, DVDs can achieve a storage capacity of around 5GB for one side of an optical disc of the same diameter (120mm) as a CD.

[0009]

As described above, since DVDs have a recording

capacity which is around ten times greater than a CD, it becomes possible to record high-quality moving picture data which is of considerable data size. Accordingly, while video CDs used MPEG1 methods, DVDs use MPEG2 methods which can achieve higher picture quality for moving pictures.

[0010]

Multimedia Optical Disc

The following is an explanation of the characteristics of an application which uses a DVD of the construction described above.

[0011]

The large storage capacity of DVDs allows the realization of a great variety of applications, including, of course, movie applications with improved image quality. These applications include multi-title applications, where the large storage capacity is used to store a plurality of sets of moving picture data, a plurality of sets of audio data, and a plurality of the sets of graphics data which are selectively reproduced in accordance with interactive operations made by the user. While standard music applications and movie applications have only one reproduction route, multi-title applications differ in that they contain branches which are selectively executed in accordance with user operations, so that multiple reproduction routes are provided. Here, examples of such a multi-title application are an aerobics instruction title

which has separate video clips for different exercises and a guidebook application for foreign holidays. In Fig. 10(a), each circular mark represents a video clip which is an MPEG stream, while the arrows show the next video clip in the reproduction route. These video clips have been numbered M1 ... M5, and have the content given in the table in Fig. 10(b). In the example shown in Fig. 10, the title is a guide to tourist spots, with each video clip storing images of tourist spots. Two reproduction routes are provided in the example in Fig. 10, with one being the reproduction route for a detailed description of the tourist spots, while the other only gives a simplified description. The reproduction route for the detailed description is composed of video clips M1 to M5, while the reproduction route for the simplified description is only composed of video clips M1, M2, and M5. In these video clips, M1 shows the selection items used for selecting one of the detailed description and simplified description. As can be seen from the figure, video clips M1, M2, and M5 are included in both reproduction routes, so that these video materials are reproduced no matter what reproduction route is selected.

[0012]

As a further characteristic of DVD reproduction routes, it is possible to indicate special reproduction features as attributes of the routes, in addition to having a standard continuous reproduction of the data. As one

example, suppose that reproduction route K is composed of MPEG streams M1, M3, and M8 which are to be reproduced in that order. Here, if the route attribute is continuous reproduction, reproduction control will be performed so that the streams are reproduced in that order. However, if the route attribute is "selective reproduction" which is indicated as a special reproduction feature, one of the MPEG streams which composes the reproduction route K will be selected at random and reproduced. Here, a number of repetitions for repeated reproduction may also be specified for the special reproduction, so that if "three times" is specified as the number of repetitions, the content of the reproduction may differ every time, such as M1, M8, M1 or M8, M3, M3. This kind of function may be used in applications where a different content is desirable every time reproduction is performed, such as for mental arithmetic drills.

[0013]

Multi-applications, which store multiple applications, are also possible as another example of a special DVD application, thereby making the most of the large storage capacity of DVDs. As examples, when each of these applications is a movie, a plurality of such movies, or movies and guide information can be grouped together as multi-applications. As another example, catalogs for the clothes or automobiles which appear in a movie can be

additionally provided as a separate application. When doing so, movie scenes which include a certain automobile can have a button displayed to allow the use to refer to the car catalog, with the reproduction switching to the catalog application when the button is selected. Here, it is also possible to provide a multimedia application in which catalog information and scenes from the movie are mixed, but if these kinds of information are kept separate, there is the additional benefit of the user being able to watch the entire movie without having to view the catalog. As a result, when developing DVD software, an application producer is free to choose which type of application to use.

[0014]

Functions of the Disc Reproduction Apparatus for a Movie Application

The following is an explanation of the functions of a conventional optical disc reproduction apparatus for a movie application that has only one reproduction route, as a prelude to the explanation of the present invention.

[0015]

Discs and reproduction apparatuses which have only one reproduction route, such as CDs, video CDs, or laser discs, are provided with a feedback function for informing the user of the present state of reproduction. These functions can be performed by the disc reproduction apparatus regardless of the content of the disc, and include a function

displaying the reproduction expired time and an index number display function displaying a present index number. For movies, index numbers can be used to display chapter numbers in the movie, while for music, index numbers can be used as song numbers. Here, some disc reproduction apparatuses have also been equipped with search functions where users can indicate their desired data by indicating a reproduction expired time or an index number. Fig. 11 shows the relationships between recording addresses, reproduction expired time, and chapter numbers (index numbers) for a conventional disc with only one reproduction route. Here, chapter numbers and reproduction expired time directly correspond to disc recording addresses, so that as the disc reproduction apparatus monitors the recording address of the data being reproduced, it can soon convert the recording address into a chapter number or reproduction expired time in response to a user request for a feedback function. In the same way, when a search function is requested, if the user specifies a chapter number or reproduction expired time, the disc reproduction apparatus can calculate the corresponding disc recording address and commence reproduction from the calculated recording address. Here, it is also possible to provide a programmed reproduction function where reproduction is performed according to an order of chapter numbers or song numbers indicated by the user, and a random reproduction function where chapters or

songs are selected at random.

[0017]

1. Problems with the Feedback Function

When performing a chapter number display function, it is necessary to prohibit the function when the reproduction route is not linear in construction, since there is the possibility that chapters will not be sequential. For the example shown in Fig. 10 where there are multiple reproduction routes (and therefore a non-linear construction), suppose that M2 in reproduction route 1 is given the chapter number 1, M4 the chapter number 2, and M5 the chapter number 3. When doing so, it is not possible to give the chapter M2 in reproduction route 2 the chapter number 2. As a result, inconsistencies occur in the search function due to the allocation of these chapter numbers.

[0018]

When allocating unique chapter numbers, the problems with the search function can be solved, although the same content will be allocated several chapter numbers, which confuses the viewer. If, for example, M2 in reproduction route 2 is allocated the chapter number 4, chapter number 3 will be displayed for the following chapter M3, so that continuous chapter numbers will not be displayed, which confuses the viewer. This is also the case with the reproduction expired time display function, so that when the reproduction routes have the construction shown in Fig. 10

and the reproduction apparatus displays the reproduction expired time, there is the risk that inconsistencies will appear in the displayed time, so that such display operations should be prohibited. As one example, when video clip M5 is displayed in reproduction route 1, the reproduction time expired before its commencement will differ from that when it is displayed as part of reproduction route 2. As a result, potential inconsistencies can result from the branch selection of reproduction route.

[0019]

2. Problems with the Index Search Function

When performing a time search function, when an indicated search time exceeds the range of reproduction time which can be managed by the reproduction device, the reproduction device will not be able to verify the indicated time quickly. During execution, it is necessary to trace the reproduction routes, so that it will not be possible to perform an error judgement process quickly. For the example of Fig. 10, when a time which exceeds the reproduction time of M1 is indicated during the reproduction of M1, since a branch selection is performed once reproduction of M1 is completed, the device will not know which branch is to be selected, resulting in inconsistencies. As one example, when a disc only has one reproduction route which is thirty minutes in length and the user indicates a time search for a

reproduction expired time of forty minutes, it is necessary to prohibit the operation since the indicated time exceeds the total reproduction time. For the case shown in Fig. 11 with only one reproduction route, correspondence is established between the disc recording addresses and the disc recording addresses. As a result, the reproduction apparatus can calculate the disc address corresponding to the indicated time, and so instantly judge whether the value is valid. For the case in Fig. 10, however, correspondence is not established between the disc addresses and the reproduction expired time, so that the disc reproduction apparatus cannot judge whether a time search indicated time is valid simply from the calculated disc address. As a result, it is necessary to investigate the construction of the reproduction routes to judge whether the indicated time search value is within the total reproduction time of the disc. However, as household devices, it is necessary for DVD players to operate with limited memory, so that instead of storing all of the route information in a memory, it is conventional for DVD players to divide the route information into unit length and to perform reproduction with only the necessary route information stored in the memory. As a result, a large number of disc seek operations are necessary to investigate the route construction of the entire disc for the indicated time search value, so that a great deal of time is required just to judge whether such time search

function is valid.

[0020]

3. Programmed Reproduction Function,

Random Reproduction Function

Since a plurality of applications are recorded on a single DVD, it is possible to conceive a programmed reproduction function or random reproduction function for these applications. However, when branches to other applications are executed within such applications, problems can arise with such programmed/random reproduction.

[0021]

Problems caused during Special Reproduction

As described above, in addition to conventional reproduction features, DVDs can have special reproduction features indicated as attributes of reproduction routes. The problems with multiple reproduction routes are as described above, although even when only one reproduction route is present, the same kinds of problems can arise when the reproduction route has special reproduction features.

[0022]

In view of the stated problems, it is an object of the present invention to provide a multimedia optical disc and reproduction apparatus which can quickly judge whether functions for movie applications, such as feedback functions, index search functions, and program reproduction functions, are possible during the reproduction of an

application, and, when such functions are not possible, which can guard against erroneous operations by prohibiting the functions.

[0023]

Means for Solving the Stated Problems

In order to solve the stated problem, the invention of Claim 1 is an optical disc that has at least one information layer between a first and second transparent substrate which have an equal thickness of 0.6mm or below, characterized by including: a system stream recording area for storing system streams which include at least video information and reproduction control commands; and a reproduction control information recording area that stores a plurality of sets of system stream reproduction control information each expressing at least one system stream reproduction order and reproduction control commands to be automatically executed during reproduction, first flag information showing characteristics of the title connection structure as management information for a title which is made up of one or more sets of system stream reproduction control information that are linked together during reproduction, and second flag information showing characteristics of the reproduction control commands included in a title.

[0024]

The invention of Claim 2 is the multimedia optical disc of Claim 1, wherein the first flag information stores a

single sequential system stream control information flag showing that the title is composed of only one set of system stream control information and that the system streams indicated by the system stream control information are reproduced in order, and wherein the second flag information stores a no automatic branch flag which indicates that the title does not include any automatically executed commands which cause branches in the reproduction route.

[0025]

The invention of Claim 3 is the multimedia optical disc of Claim 1, wherein the second flag information stores, in addition to the no automatic branch flag, a no inter-title branch flag which shows that a title does not include reproduction control commands which perform branches between titles during reproduction.

[0026]

The invention of Claim 4 is a reproduction apparatus which reproduces and outputs video and audio stored as information on an optical disc, the apparatus being provided with AV disc functions to be executed during reproduction where there is only one reproduction route, comprising: a reproduction means for reproducing the optical disc of Claim 1 and for outputting system streams, system stream reproduction control information, and the first flag information and the second flag information which is attribute information for a title; first flag storage means

for storing the first flag information for the title being reproduced; second flag storage means for storing the second flag information for the title being reproduced; input means for inputting external requests for the execution of AV disc functions; function permission table storage means for storing a function permission table which shows pairings of the first and second flag information as execution permission conditions for the AV disc functions; and control means for determining system streams to be reproduced in accordance with system stream reproduction control information and performing reproduction control, as well as judging, when the input means receives an external request for the execution of a AV disc function, whether the requested function is possible, based on the first and second flag information and the function permission table, before executing the received function only when it is permitted.

[0027]

The invention of Claim 5 is the reproduction apparatus of Claim 4, wherein the AV disc functions at least include a feedback function, with the execution permission condition for the feedback function in the execution permission table being the setting of both the single sequential PGC identification flag and the no automatic branch flag.

[0028]

The invention of Claim 6 is the reproduction apparatus

of Claim 4, wherein the AV disc functions include at least a search function, with the execution permission condition for the search function in the execution permission table being the setting of both the single sequential PGC identification flag and the no automatic branch flag.

[0029]

The invention of Claim 7 is the reproduction apparatus of Claim 4, wherein the AV disc functions include at least a programming function and a title programming function, with the execution permission condition for the programming function in the execution permission table being the setting of both the single sequential PGC identification flag and the no automatic branch flag, and the execution permission condition for the title programming function in the execution permission table being the setting of both the single sequential PGC identification flag and no inter-title branch flag.

[0030]

The invention of Claim 8 is the reproduction apparatus of Claim 5, further comprising a state display unit which updates a displayed index number in accordance with the feedback function and which displays a title number together with the index number.

[0031]

Embodiments of the Present Invention

The following is an explanation of the first embodiment of the present invention, with reference to the drawings.

[0032]

The description will first focus on the logical construction of the optical disc used in the present embodiment.

Fig. 1 shows a cross-section of a DVD. Starting from the bottom, DVD 107 is formed of a first transparent substrate 108 which is 0.6mm thick, on top of which an information layer 109 made of a reflective membrane such as metal foil is attached, with a bonding layer 110 and then a second transparent substrate 111 being formed on top of the information layer 109. If necessary, a print layer 112, or in other words a printed label, is formed on top of the second transparent substrate 111.

[0033]

Here, it is not necessary for this print layer 112 to cover the entire disc, so that parts of the second transparent substrate 111 may be left exposed.

[0034]

In Fig. 1, the bottom side of the disc onto which light beam 113 is shone and from which information is read is set as the front surface A, while the top side of the disc with the print layer 112 is set as the rear surface B. Here, indented and protruding pits are formed in the

information layer 109 side of the first transparent substrate 108 by a manufacturing process, with information being recorded by varying the length of pits and the intervals between them. Here, the indentations and protrusions of the pits in the first transparent surface 108 are imprinted into the information layer 109. The lengths of the pits and intervals for this disc are shorter than on a conventional CD, with the pitch of the information tracks in which the pit streams are formed also being narrower, which results in improved surface storage density.

[0035]

The surface A side of the first transparent substrate 108 in which pits are not formed is flat. The second transparent substrate 111 is a reinforcer and is made of the same thickness (0.6mm) of the same material as the first transparent substrate 108, with both of its surfaces being flat.

[0036]

Information is retrieved from this kind of disc by shining the light beam 113 on the disc and focusing it on the information layer 109. Here, there is a change in the phase of the reflected light between when there is a pit and a surrounding area, so that optical interference occurs and the reflectivity ratio is reduced. Meanwhile, when there is no pit, such interference does not occur and the reflectivity ratio increases. By measuring such changes in

the reflectivity ratio, reproduction of the disc is performed. The light spot 114 on a DVD has a diameter of around 1/1.6 times the diameter of a light spot on a conventional CD due to an increase in the numerical aperture NA and a reduction in the wavelength λ of the light beam. DVDs of the physical construction described above can store almost ten times the storage capacity of a conventional CD, which is to say around 4.7Gbytes.

[0037]

The following is a description of the logical construction of the optical disc described above, with frequent reference to the terminology used to describe the logical construction of DVD applications. As a result, this terminology will be defined together with the logical construction of the applications recorded on the optical disc.

[0038]

In the present embodiment, the unit for applications on a DVD is a title. If titles are movie applications, then each title will be one movie. As a result, an optical disc which stores three titles will store three movies. Here, title is a high level concept, with the concept "title set" being used for a plurality of titles which share the same moving picture information. As one example, when there are three versions of a movie, such as an uncut version, a general release version, and a television broadcast version,

which for the most part use the same video material, these three versions will be set as one title set. Here, it is possible for a plurality of title sets to be recorded on one DVD. Here, each title is composed of MPEG streams known as "cells" and reproduction route information which indicates the cells which compose the title.

[0039]

The reproduction order for cells is shown as system stream reproduction control information. In the present embodiment, a set of system stream reproduction control information is called a program chain. These program chains can be logically linked to each other by a cell for a menu, or the like, and form reproduction routes which may include branches. Linked program chains form one title set. Here, reproduction routes given as program chains are divided into a plurality of units called "programs". These programs are used as the units for performing access during an index search, such as a chapter number search.

[0040]

The following is a description of the data construction used for recording data on an optical disc such as a DVD, when applications have the logical construction described above. This description will refer to Figs. 2, 3, 4, and 5.

[0041]

The data recorded on an optical disc, such as a DVD,

is arranged so that there is a lead-in area, a data area, and a lead-out area which are arranged in order from the inner periphery of the disc to the outer periphery. The lead-in area tells the disc reproduction apparatus to prepare for the start of reproduction, while the lead-out area indicates the end of recorded information to the disc reproduction apparatus. The data area is used to record the volume data and is managed as a one-dimensional array of logical blocks which are 2,048 bytes in size and which each have a unique block number. This volume data is composed of a plurality of sets of file data and management information for managing the file system for the entire disc.

[0042]

Fig. 2 shows the data construction for the entire DVD used in the present embodiment, aside from the management information used to manage the file system. Here, the recorded information is composed of a plurality of video management files and a plurality of video files. Each video file stores information for the reproduction of the various video files, while video management files store information for managing all of the title sets. The construction of each video file is shown in Fig. 2(c). Each video file is composed of video file management information and video file data. Each set of video file data stores all of the MPEG streams which compose the title set. Each set of video file management information stores management information for

reproduction control of the plurality of MPEG streams stored in the video data according to the plurality of reproduction routes. Fig. 2(b) shows the construction of each video management file. Each video management file is composed of video file management information and video data, with the video file management information storing index information for the video title set and setting information, such as for the audio and sub-picture settings. The video data; meanwhile, stores the MPEG streams for the menu image which allows the user to select the title set to be reproduced.

[0043]

The following is a detailed description of the data construction of the video management file and the video file. This description will first focus on the video file management information in the video file and will refer to Fig. 3.

[0044]

Fig. 3 shows the construction of the video file which is central to the video file management information. The video file management information is composed of a video file management table, a video file internal title search pointer table, a program chain information table, and a time map table.

[0045]

The video file management table stores header information including video file internal title search

pointers and pointers to the program chain information table as management information for the entire video file, in addition to attribute information for the video data, such as the number of audio streams for the video data stored in the video file, the attributes of each audio stream, the number of sub-picture streams for the video data stored in the video file, and the attributes of each sub-picture stream.

[0046]

The video file internal title search pointers each store index information of a title corresponding to a title number. Each index is composed of a PGC information entry number and a program number, so that a reproduction apparatus can access PGCs in units of one program.

[0047]

The program chain information table is composed of PGC information which defines reproduction orders for a plurality of MPEG streams of video data. This PGC information is composed of PGC management information, a command table, a program map, PGC reproduction control information, a number of storage cells, and cell control information. The PGC management information is not related to this invention, and so will not be described in detail. The PGC management information stores information which is valid during reproduction and information for overall management of the system, such as total reproduction time,

and a color conversion table which is used for the sub-picture information during reproduction. The command table stores, for each PGC, pre-processing commands which are to be automatically executed prior to the commencement of reproduction control, post-processing commands which are to be automatically executed after the completion of reproduction control, and cell commands which are to be automatically executed when each of the cells indicated by the reproduction order of the PGC has been reproduced. The program map stores the program number allocated to each cell in a PGC. The PGC reproduction control information stores link relations with other PGCs and a reproduction mode. Here, link relations are relations which express links with PGC information for a preceding and succeeding PGC on the reproduction route. The reproduction mode indicates either sequential reproduction or special reproduction. During sequential reproduction, the cells which form the PGC are reproduced in order following the entry order, while during special reproduction, cells are not reproduced in a sequential order, and are instead reproduced in according to one of random reproduction and shuffle reproduction. In both random reproduction and shuffle reproduction, one cell is selected and reproduced at random. In setting special reproduction, the number of loop iterations can be specified, so that random reproduction is only performed for the specified number of iterations.

[0048]

The difference between random reproduction and shuffle reproduction lies in whether repeated selection is permitted, with repeated selection of a same cell being prohibited during shuffle reproduction. The number of storage cells is given by the total number of cells whose reproduction order is indicated by a PGC. The cell control information stores the reproduction order of each cell (which is an MPEG stream) and the address on the multimedia optical disc of each cell. The cell control information also stores information which indicates cell commands in the command table which are to be executed when the reproduction of each cell is complete. It should be noted here that the entry order shows the reproduction order, and that this reproduction order refers to cells which have the video data of the video file to which video file management information belongs, so that this reproduction order does not refer to cells stored in other video files.

[0049]

The time map table stores information for each PGC which is used for converting the reproduction expired time of the PGC to a reproduction expired time. More specifically, disc address information is stored for the cells to be reproduced in accordance with the reproduction route of a PGC in units of a specified time, such as three seconds. This relationship between cells and disc addresses

at which cells are stored will be described in more detail later as part of the description of the video data. Note here, however, that disc address information which allows access to the cells in units of around 0.5 seconds is stored.

[0050]

In order to commence the reproduction of a title, the reproduction apparatus refers to the video file title search pointers and obtains the address of index#1 for the corresponding title number. It then selects the PGC information given by this address from the PGC information table, and enables execution from the program number also indicated by this address. If the reproduction apparatus stores the PGC information number and program number for the present reproduction, it also becomes possible to know the index information corresponding to the data currently being reproduced.

[0051]

It should be noted here that the reproduction apparatus converts the disc address information for an MPEG stream which is presently being reproduced using a time map corresponding to a PGC for the present reproduction route, so that it can obtain the reproduction expired time at the PGC level. By doing so, the reproduction apparatus can know the reproduction expired time corresponding to the data presently being reproduced.

[0052]

The following is an explanation of video data in the video file, with reference to Fig. 4.

Fig. 4 shows the data construction of the video data. This video data is composed of a plurality of MPEG system streams. Each system stream is called a "cell", as described above. Each cell has a 2Kbyte data block as one pack, and is composed of video, audio, sub-picture, and management information which are interleaved. Video information is composed of a unit called a GOP (Group of Pictures) which is used as the unit for inter-frame video compression and decompression, with each GOP being composed of a plurality of video packs. Audio information is interleaved into cells as audio packs, with the audio packs having a stream number from "0" to "7" as identification information. These audio packs are grouped in accordance with their stream numbers to form eight separate channels of audio information. When movie applications support multiple languages, each audio channel is used to store a soundtrack in a different language. Sub-picture information is interleaved into cells as sub-picture packs, with the sub-picture packs having a stream number from "0" to "31" as identification information. These sub-picture packs are grouped in accordance with their stream numbers to form thirty-two separate channels of sub-picture information. Here, sub-picture information is used for storing subtitles

or graphics for displaying menu items and menu buttons. Management information is stored before the GOPs of video information and is interleaved into the GOPs as management packs. These management packs each store a DSI (Data Search Information) packet and a PCI packet (Presentation Control Information) Packet. This DSI packet stores information which is necessary for the reproduction for the MPEG stream from the present data position, and is set at the smallest unit for reproduction. Here, information for the synchronizing of video information and audio information is stored in the DSI packet, in addition to information referred to during special reproduction, such as during a fast forward operation. As shown in Fig. 4(b), the PCI packet stores one or more sets of selection indication information (called "buttons") for receiving user interaction from outside the system. These sets of selection indication information stored in GOP units are called highlight information, and are used in the realization of buttons for user interaction and menu items, as well as for the display of the sub-picture. Here, each button is composed of an indication of a screen area and a color which are used when selection and confirmation operations are performed by the user, as well as information for the command which is to be executed when the button is selected. These commands can be command which change the program chain used for managing the reproduction order.

[0053]

It should be noted here that on reaching a branching point in a reproduction route, it is necessary to display a menu so that the user can select the desired route. The reproduction apparatus displays such a menu as the main image using the data in the video packs of the MPEG stream, and at the same time refers the highlight information in the management pack interleaved with the menu images to execute color changing for a selected/confirmed button and a command corresponding to a confirmed button.

[0054]

This completes the explanation of the video file, so that the following explanation will deal with the video management file. The data construction of this video management file is shown in Fig. 5. The video management file is composed of video data which stores cells that are MPEG streams and video management file management information which is management information for this video data.

[0055]

The video management file management information is composed of a video management file management table, a title search pointer table, a menu program chain information table, and a title set attribute table.

[0056]

The video management file management information is

header information which contains pointer information to other table information. It also stores attribute information, such as the number of audio streams and sub-picture streams of the MPEG streams stored as cells in this video management file.

[0057]

The title search pointer table is made up of a title reproduction type for each title corresponding to each title number, and access information. The access information stores the title set number to which it belongs, the title number within the title set, and the starting address of the title set. It should be noted here that the starting address of the title set is supplementary information for enabling the reproduction apparatus to perform direct access without referring to the file system. The title reproduction type stores flags which indicate the structural and functional characteristics of the title. These flags are composed of a single sequential PGC identification flag, a no automatic branch flag, and a no inter-title branch flag.

[0058]

The single sequential PGC identification flag shows whether a title only has one reproduction route which is composed of one PGC that is executed sequentially. This kind of single sequential PGC is shown in Fig. 12A. Here, the rectangle represents the program chain, while the

circles represent cells. In Fig. 12A, there is only one PGC, PGC#1, and so only one reproduction route. In this case, the single sequential PGC identification flag is set. Fig. 12B shows the reproduction route of a title which is not a single sequential PGC title. This title in Fig. 12B is reproduced sequentially, but is composed of multiple PGCs, PGC#2 and PGC#3, so that the single sequential PGC identification flag is not set. Fig. 12C also shows a title which is not composed of a single sequential PGC. This title in Fig. 12C is composed of one PGC, but this PGC is not reproduced sequentially as special reproduction is performed. As a result, the single sequential PGC identification flag is not set.

[0059]

The no automatic branch flag shows that a title has no automatic branches. In the present embodiment, both manual and automatic branches are possible. Here, an automatic branch is a branch which is automatically executed without requiring user interaction, with an example of such being shown in Fig. 13A. In Fig. 13A, the MPEG stream M3 which is last in the reproduction order is provided with an instruction that performs a number of branches stored in a counter as its cell command. This is to say, this cell command is a command which is automatically executed on the completion of reproduction of the cell and is a command for an automatic branch, so that the no automatic branch flag is

not set. Since an automatic branch is always executed when a branch instruction is included as an automatically executed command in the reproduction route, the no automatic branch flag is never set when a branch instruction is stored as a cell command in a PGC. Here, if no branch instructions are present as cell commands, the reproduction apparatus considers that there are no automatic branches and so sets the no automatic branch flag.

[0060]

The following is a supplementary explanation of manual branches, an example of which is shown in Fig. 13B. In this example, MPEG stream M13, whose reproduction order is set by PGC#6, is equipped with a button to allow repeated reproduction. This button stores an instruction which branches to MPEG stream M12 at the start of PGC#6. Here, if the user selects and confirms this button, a branch to MPEG stream M12 is performed. This, however, is not regarded as an automatic branch. Another example of a manual branch is shown in Fig. 13C. In this example, a branch instruction is provided for switching between titles, so that a button is displayed for switching to another title during an MPEG stream. If the user selects and confirms this button, the reproduction switches to another title. This branch is however a manual branch, so that the no automatic branch flag will still be set.

[0061]

The no inter-title branch flag shows that a title includes no branches to another title. If there are no branch instructions to other titles as button commands, PGC cell commands, pre-processing commands, or post-processing commands, the reproduction apparatus considers that there are no branches to other titles and so sets the no inter-title branch flag. Here, if any of a PGC cell command, pre-processing command, or post-processing command includes a branch command to another title, the no inter-title branch flag is not set.

[0062]

The menu program chain information table stores PGC information for reproduction control of cells for displaying menu images which are stored in the video management file. This menu is used as the menu for all of the titles whose reproduction may be indicated by the user.

[0063]

The title set attribute table contains attribute information such as the number of audio streams in the title set, the number of sub-picture streams, the data attributes of each audio stream, and the data attributes of each sub-picture stream.

[0064]

This completes the description of the DVD of the present embodiment, so that the following explanation will focus on the reproduction apparatus of the present

embodiment.

[0065]

Fig. 6 is a block diagram showing the construction of the reproduction apparatus of the present embodiment. As shown in Fig. 6, the reproduction apparatus is composed of an optical disc 200, a motor 201, an optical pickup 202, a mechanism control unit 203, a signal processing unit 204, an AV decoding unit 205, a remote controller 206, a remote control receiving unit 207, a system control unit 208, and a state display unit 209.

[0066]

The following is a description of each of the components given above.

The optical disc 200 is a multimedia optical disc which is a DVD. Its physical construction is shown in Fig. 1, and its logical construction is shown in Figs. 2 through 5.

[0067]

The mechanism control unit 203 controls a mechanism which includes the motor 201 which drives the optical disc 200 and the optical pickup 202 which reproduces the signal recorded on the optical disc 200. More specifically, the mechanism control unit 203 performs control for rotating the optical disc 200 and reading data in accordance with a control signal from the system control unit 208. In doing so, the mechanism control unit 203 has the optical pickup

202 read the data from the specified address on the optical disc 200 so that it can output the reproduced signal.

[0068]

The signal processing unit 204 demodulates the reproduced signal from the optical pickup 202 and performs a variety of predetermined processes, such as error correction, before converting the signal into digital data. The converted digital data is then stored in the buffer memory (not illustrated) of the system control unit 208. If the digital data is MPEG stream data, it is transferred to the AV decoding unit 205. Data which is not MPEG stream data, such as PGC information, is stored inside the system control unit 208, and is used when performing various kinds of control operations.

[0069]

The AV decoding unit 205 is composed of a system decoder 2051, a video decoder 2052, a sub-picture decoder 2053, an audio decoder 2054, and an image mixing unit 2055. This AV decoding unit 205 separates the inputted system stream data into a video signal, an audio signal, and the like. The components of the AV decoding unit 205 are described in more detail below.

[0070]

The system decoder 2051 judges the packets which compose the system stream data sent from the buffer memory and outputs video packs to the video decoder 2052, audio

packs to the audio decoder 2054, sub-picture packs to the sub-picture decoder 2053, and management packs to the system control unit 208. When judging that a packet contains an audio pack or sub-picture pack, the system decoder 2051 examines the audio stream ID or sub-picture stream ID and discards data in audio packs and sub-picture packs which do not have the audio stream ID or sub-picture stream ID indicated in the control signal received from the system control unit 208.

[0071]

The video decoder 2052 decodes the data in the video packs inputted from the system decoder 2051 and subjects the data to a suitable decompression process for MPEG to convert it digital image data which it then outputs to the image mixing unit 2055.

[0072]

The sub-picture decoder 2053 decodes the data in the sub-picture packs sent from the system decoder 2051 and, in accordance with the data type of the decoded graphics, converts the graphics into digital image data which it outputs to the image mixing unit 2055. More specifically, in the present example, the sub-picture decoder 2053 subjects the inputted data to run-length decompression. In doing so, color information may be used to switch the color of the sub-picture data in accordance with highlight control which is described later.

[0073]

The audio decoder 2054 decodes the audio packs inputted from the system decoder 2051 and converts them into an audio signal which is outputs to the periphery. This outputted audio signal is then reproduced by a speaker attached to the reproduction apparatus.

[0074]

The image mixing unit 2055 mixes the output from the video decoder 2052 and the output of the sub-picture decoder 2053 at a mixing ratio indicated by the system control unit 208 and outputs the resulting video signal. This outputted signal is converted into an analog image signal and is then displayed by a display apparatus attached to the reproduction apparatus.

[0075]

This concludes the explanation of the AV decoding unit 205.

The remote controller 206 is used to receive reproduction control indications made by the user. An example of the interface of the remote controller 206 is shown in Fig. 9. Here, the ten key is used in conjunction with the other keys to make numerical inputs. The cursor keys are used to change the selections of buttons. The "ENTER" key is used to confirm user selections. The "CHAPTER" key and "TIME" key are provided as keys indicating search operations. When the user presses either of these

keys and makes a numerical input, the inputted numerical value will be displayed on the display apparatus. If the user then presses the "CHAPTER" key or "TIME" key again, a search instruction for the indicated chapter or time will be executed. A "TITLE PROGRAM" key and a "PROGRAM" key are also provided as keys indicating programmed reproduction, with an initial pressing of these keys preceding a numerical input which in this case is used to specify a reproduction order. As before, a second pressing of the same key confirms the instruction. Here, the reproduction order indicated when pressing the "TITLE PROGRAM" key is the reproduction order for titles, while the reproduction order indicated when pressing the "PROGRAM" key is the reproduction order for chapters within a given title. As one example, if the user indicates the reproduction order "3", "4", "2" using the "TITLE PROGRAM" key and the ten key, title number "3", title number "4", and title number "2" will be reproduced in that order.

[0076]

The remote control receiving unit 207 receives an infra red transmission every time a button is pressed on the remote controller 206, and generates interrupts to inform the system control unit 208 of the key data. Here, examples of the received instructions sent to the system control unit 208 are reproduction start instructions, reproduction stop instructions, button selection operations, button confirm

operations, chapter search instructions for an indicated chapter number, time search instructions for an indicated time, chapter programming instructions including a chapter reproduction order, and title programming instructions including a title reproduction order.

[0077]

The state display unit 209 displays the present title number, chapter number, and reproduction expired time in accordance with an indication from the system control unit 208. Also on receiving a display invalidity signal from the system control unit 208, the state display unit 209 does not display the title number, chapter number, or reproduction expired time.

[0078]

The system control unit 208 is composed of a program memory for storing a program that achieves all of the functions of the system control unit 208, a work memory which is necessary for executing the program, a buffer memory for storing the logical blocks of data on the disc, a CPU for executing the program, and an interface control unit. This system control unit 208 controls the entire reproduction apparatus.

[0079]

The following is a more detailed explanation of the logical construction of the system control unit 208, with reference to Fig. 7. As shown in Fig. 7, the system control

unit 208 includes a remote control input interpreting unit 71, a reproduction control unit 72, a button control unit 73, a command interpreting/executing unit 74, a system state management unit 75, and a valid function determining unit 76.

[0080]

The remote control input interpreting unit 71 interprets the remote control key data received by the remote control receiving unit 207. This key data can be reproduction start instructions, reproduction stop instructions, button selection operations, button confirm operations, chapter search instructions for an indicated chapter number, time search instructions for an indicated time, chapter programming instructions including a chapter reproduction order, and title programming instructions including a title reproduction order. The remote control input interpreting unit 71 outputs button selection instructions and button confirm instructions to the button control unit 73, and outputs reproduction start instructions, reproduction stop instructions, chapter search instructions, time search instructions, chapter programming instructions, and title programming instructions to the reproduction control unit 72.

[0081]

The button control unit 73 stores the data in the management pack of the MPEG stream which is currently being

reproduced. This management pack is sent from the remote controller 206. Also, when a button selection instruction or a button confirm instruction is inputted from the remote control input interpreting unit 71, the button control unit 73 outputs a control signal to the AV decoding unit 205 to change the color of sub-picture in the screen area which is allocated to the indicated button, in accordance with the highlight information in the PCI management pack currently being stored. Also, when there is a button confirm instruction, the command which is assigned to the indicated button is transferred to the command interpreting/executing unit 74.

[0082]

The command interpreting/executing unit 74 interprets the command inputted from the button control unit 73 and, when the command indicates a change of PGC information to change the course of reproduction, outputs a reproduction control instruction notifying the reproduction control unit 72 of the new PGC information. Alternatively, when there is a change in the state of the parameters held within the system, the command interpreting/executing unit 74 outputs a system state control instruction notifying the system state management unit 75.

[0083]

The valid function determining unit 76 stores the flag information for the structural characteristics and

functional characteristics of the title currently being reproduced, and, when there is a function execution permission request from the system state management unit 75 or the reproduction control unit 72, judges whether the requested function is permitted or not permitted before informing the requesting unit of its judgement. In more detail, the valid function determining unit 76 is composed of a route construction flag storage unit 761, a route function flag storage unit route function flag storage unit 762, and an AV application function permitting unit 763. The route construction flag storage unit 761 stores a single sequential PGC flag which shows whether a title has the structural characteristics shown in Fig. 5[1]. The route function flag storage unit 762 stores the no automatic branch flag and the no inter-title branch flag. It should be noted here that the information stored by the route construction flag storage unit 761 and the route function flag storage unit 762 is information which shows the characteristics of the reproduction route(s) made up of the PGCs which form a title, so that this information is updated when reproduction control in performed by the reproduction control unit 72 to switch titles. The AV application function permitting unit 763 records the function permission judging table information shown in Fig. 14 on a ROM (not-illustrated) provided inside the system control unit 208.

[1]Mistake in original text

Here, the indication of permitted functions is performed by examining whether certain combinations of flags are set in accordance with the function permission judging table. As specific examples, the chapter number display function, the reproduction expired time display function, the chapter number search function, the time search function, and the chapter programming function are only permitted when the single sequential PGC identification flag and the no automatic branch flag are set. The title programming function, on the other hand, is only permitted when the single sequential PGC identification flag and the no inter-title branch flag are set.

[0084]

The system state management unit 75 further includes the group of state registers 751.

[0085]

The group of state registers 751 is made up of a variety of registers showing the present state of the reproduction apparatus, with these including an audio channel register, a sub-picture channel register, a title number register, a program number register, an index number register, a chapter number register, and a reproduction expired time register. Here, the audio channel register stores the channel number of the presently selected audio channel, while the sub-picture channel register stores the channel number of the presently selected sub-picture

channel, so that a control signal can be outputted to the AV decoding unit 205 showing the audio and sub-picture channels which are to be reproduced. When reproduction is commenced by the reproduction control unit 72, the title number of the selected title is stored in the title number register. Title numbers are set as the entry number of the title pointer in the video file title search pointer table shown in Fig. 3. When the title to be reproduced has been decided, the starting PGC information for this title is determined by the reproduction control unit 72, and the entry number for this PGC information in the program chain information table is stored in the PGC number register. Cells are also reproduced in the reproduction order given by the PGC information determined by the reproduction control unit 72, with the program number that is the classification number of the cell currently being reproduced being stored in the program number register. The entry number of the index address, determined from the program information entry number and the program number, is stored in the index number register. The chapter number register and the reproduction expired time register respectively store the present chapter number and reproduction expired time, although when the value of the title number register changes, a chapter number display function permission request and a reproduction expired time display permission request are outputted to the valid function determining unit 76, and, if the execution of

these functions is permitted by the valid function determining unit 76, the chapter number or reproduction expired time is calculated according to a predetermined process and the content of the respective registers is updated. When the values of the title number register, the chapter number register, and the reproduction expired time register are updated, a control signal indicated the updated values is outputted to the state display unit. If the execution of the chapter number display function or the reproduction expired time display function is prohibited by the valid function determining unit 76, a control signal showing invalidity is sent to the state display unit 209.

[0086]

The reproduction control unit 72 performs various predetermined control operations in accordance with reproduction start instructions, reproduction stop instructions, chapter search instructions, time search instructions, chapter programming instructions, or title programming instructions from the remote control input interpreting unit 71, or reproduction control instructions inputted from the command interpreting/executing unit 74.

[0087]

If the inputted instruction is a reproduction start instruction, the reproduction control unit 72 outputs a control signal to the mechanism control unit 203 and to the signal processing unit 204, reads the video management file,

and sets the title at the reproduction start time from the video management file management information. Also, as described above, the flag information for the title reproduction type in the video management file management information shown in Fig. 5 is stored in the route construction flag storage unit 761 and the route function flag storage unit 762 of the valid function determining unit 76. It should be noted here that the process for deciding the title at the reproduction start time is not related to the present invention and so will not be described in detail. For a multimedia optical disc that stores a plurality of titles, a menu for title selection included in the video management file is displayed, and the title to be reproduced is selected by the user. Once the title to be reproduced is selected by the user, the video file for the title set to which the selected title belongs is read by outputting a control signal to the mechanism control unit 203 and the signal processing unit 204, with the first set of PGC information for the selected title being taken from the program chain information table and being stored in an internal memory (not-illustrated). Once the PGC information is stored in the internal memory, the cell which is the MPEG stream to be reproduced next is determined in accordance with the cell control information in the PGC information, before being read according to a control signal sent to the mechanism control unit 203 and the signal processing unit

204, and reproduced. When reproduction control is completed for the MPEG stream which is the final cell in the reproduction order shown by the cell control information, the next set of PGC information is determined in accordance with the link information, and reproduction continues in accordance with this next set of PGC information.

[0088]

If the instruction is a reproduction stop instruction, the reproduction control unit 72 outputs a control signal to the mechanism control unit 203 and reproduction control is performed to stop the reproduction.

[0089]

If the instruction is one of a chapter search instruction, a time search instruction, a chapter programming instruction, or a title programming instruction, the reproduction control unit 72 relies on the judgement of the valid function determining unit 76 to see whether the indicated function is permitted for the title which is presently being reproduced. When the indicated function is valid, the reproduction control unit 72 uses a predetermined process to determine which cells are to be reproduced and then has these cells read by the mechanism control unit 203 and signal processing unit 204 and then reproduced.

[0090]

If a reproduction control instruction is inputted from the command interpreting/executing unit 74, the reproduction

control unit 72 determines the cells to be reproduced in accordance with this instruction and, in the same way, has these cells read by the mechanism control unit 203 and signal processing unit 204 and then reproduced.

[0091]

When these are updated by reproduction control, notification of the PGC number, the program number, and the title number is sent to the system state management unit 75.

[0092]

This completes the description of the system control unit 208 and with it the description of the construction of the reproduction apparatus, so that the following explanation will focus on the operation of the reproduction apparatus with the construction described above.

[0093]

The following explanation describes the operation of the reproduction apparatus in performing a reproduction control operation when reading and reproducing an MPEG stream recorded on an optical disc.

[0094]

The user indicates a start of reproduction using the remote controller, and on detecting such, the remote control receiving unit 207 outputs a reproduction start instruction to the system control unit 208. On receiving this reproduction start instruction, the system control unit 208 performs a predetermined process to establish the PGC

information to be executed at the start of reproduction, with cells being retrieved from the optical disc by the mechanism control unit 203 and signal processing unit 204 in accordance with reproduction order in the PGC information and then being reproduced. As one example, the initial operation here is the display on the display apparatus (not-illustrated) of the menu shown in Fig. 8 to allow the selection of the title to be reproduced. It should be noted here that the management pack of the MPEG stream for displaying this image includes highlight information for managing the buttons in the menu, with this being separated by the AV decoding unit and stored in the system control unit 208. When a button selection instruction is inputted, the system control unit 208 outputs a control signal to the AV decoding unit 205 to change the color of the screen area of the sub-picture which has been allocated to the selected button. On receiving this control signal, the AV decoding unit 205 changes the color of the specified area of the sub-picture in accordance with the control signal before outputting the sub-picture. By doing so, the display of the menu on the display apparatus changes so that the button selected by the user is displayed with the confirmation color, thereby giving the user visual feedback of the reception of the button selection. When the user uses the remote controller to give a button confirmation indication and this is detected by the remote control receiving unit

207, a button confirmation instruction is inputted into the system control unit 208. The system control unit 208 refers to the highlight information, and performs execution processing for command allocated to the button. In the present example, a branch command which branches to a first set of PGC information in a title corresponding to label information for the selected button is stored. The PGC information for the start of reproduction of the title selected by the user is then retrieved and stored by the system control unit 208, so that the system control unit 208 can set the cells to be reproduced and their reproduction order in accordance with the cell control information in the PGC information. The system control unit 208 then sends a control signal to the mechanism control unit 203 for the reproduction of the address shown in the storage cell information in the cell control information. The mechanism control unit 203 reproduces the data stored on the optical disc in accordance with the indicated address and outputs a reproduction signal to the signal processing unit 204. The signal processing unit 204 applies certain predetermined processes to this signal to convert it into digital data which is an MPEG stream and transfers the digital data in sector units to the internal buffer of the system control unit 208 in accordance with a control signal from the system control unit 208. When this digital data is transferred from the signal processing unit 204 to its internal buffer,

the system control unit 208 outputs the digital data to the AV decoding unit 205. The AV decoding unit 205 separates the inputted MPEG stream and converts it into video information, audio information, sub-picture information, and management information. Here, the management information is sent back to the system control unit 208. For the sub-picture information, only the data with the sub-picture stream number indicated by the system control unit 208 is set as being reproduced. When there is an indication from the system control unit 208, the color of an indicated region of the sub-picture is also changed, before the sub-picture information is mixed with the video information, converted to an analog image signal, outputted, and displayed by an attached display apparatus. For audio information, only the data with the audio stream number indicated by the system control unit 208 is set as being reproduced, with this data being converted into an analog audio signal, outputted, and reproduced by an attached speaker. Once the reproduction of an MPEG stream is complete, the system control unit 208 determines the next cell to be reproduced in accordance with the PGC information and the reproduction continues. Once the system control unit 208 has completed the reproduction of the final cell in the reproduction order, the next set of PGC information is determined in accordance with the link information and the reproduction continues.

[0095]

The following is a description of the operation when a command is executed. These various commands are made up of commands which are attached to sets of PGC information and which are performed irrespective of user interaction with the system and commands which are attached to MPEG streams and which are performed in response to user interaction with the system. Commands which are attached to sets of PGC information are made up of pre-processing commands which are performed at the start of reproduction for the PGC, cell commands which are performed at the end of reproduction of each cell, and post-processing commands which executed at the end of reproduction for the PGC. Here, when the PGC information for managing reproduction control is switched, the reproduction control unit 72 refers to the command table (shown in Fig. 3) for the new PGC information and transfers a pre-processing command to the command interpreting/executing unit 74, when there is one. When the reproduction of each cell is complete, the reproduction control unit 72 refers to the command table and transfers the cell command to the command interpreting/executing unit 74, when there is one. When the reproduction of all of the cells indicated by the PGC information is complete, the reproduction control unit 72 refers to the command table and transfers the post-processing command to the command interpreting/executing unit 74, when there is one. On

receiving these transferred commands, the command interpreting/executing unit 74 interprets the commands and executes them. As one example, if there is a branch instruction for transferring the reproduction to another set of PGC information, the command interpreting/executing unit 74 outputs a branch instruction to the reproduction control unit 72. There are also button commands which are attached to MPEG streams as commands. During the reproduction of the video data in the MPEG stream, the management pack which is interleaved with this video data is stored by the system control unit 208. Here, highlight information is stored as the management information corresponding to this button information displayed in the video data, so that when the user selects a button, the highlight information is referenced and the command corresponding to the selected button is transferred to the command interpreting/executing unit 74 where it is executed.

[0096]

The following is an explanation of the operation when the chapter number display function, the reproduction expired time display function, the chapter number search function, the time search function, the chapter programming reproduction function, the inter-title programming reproduction function are executed as the AV application functions of the present system.

[0097]

When disc reproduction is commenced, and the title to be reproduced has been determined by the reproduction control unit 72, the appropriate title number is set in the title number register of the system state management unit 75. Once the appropriate title number is set in the system state management unit 75, the system state management unit 75 requests execution permission for the chapter number display function and the reproduction expired time display function from the valid function determining unit 76. The valid function determining unit 76 then judges whether the execution of these functions is permitted for this title, in accordance with the flag information for the title reproduction type and the function permission judging information which it stores within its construction. Here, if the single sequential PGC identification flag and the no automatic branch flag are set, it permits the execution of these functions. When the chapter number display function is permitted, the system state management unit 75 copies the value of the chapter number register into the index register, and outputs this value to the state display unit 209 as the chapter number. On receiving a control signal for a chapter number, the state display unit 209 displays the indicated chapter number. When the value of the index register is updated, the system state management unit 75 similarly updates the value of the chapter number register and outputs the updated chapter number to the state display

unit 209. When the reproduction expired time display function is permitted, the system state management unit 75 refers to the time map in the video file management information shown in Fig. 3. This time map shows the correspondence between the reproduction expired time and the recording addresses of the management packs in the cells in each set of PGC information for a predetermined unit time. As a result, the system control unit 208 can determine the reproduction expired time for the disc from the monitored disc addresses. This is to say, the system state management unit 75 updates the value of the reproduction expired time register in accordance with the reproduced disc address using the time map. The value of this reproduction expired time register is also sent as a control signal to the state display unit 209 which displays the reproduction expired time. This state display unit 209 displays the title number, chapter number, and reproduction expired time. Here, when these functions are prohibited by the valid function determining unit 76 for the title presently being reproduced, the system state management unit 75 outputs a control signal showing that the chapter number is invalid, and/or a control signal showing that the reproduction expired time is invalid to the state display unit 209. On receiving such control signals, the state display unit 209 terminates the display of chapter number and/or reproduction expired time in accordance with the control signals. It

should be noted here that in the present embodiment, the execution permission conditions for the chapter display function are the same as those for the reproduction expired time display function, so that these functions are either permitted or prohibited together, with the state display unit 209 displaying either both or neither.

[0098]

When the user presses the keys on the remote controller to indicate one of the chapter search function, the time search function, the chapter programming reproduction function, and the inter-title reproduction programming reproduction function, the key data is infra red transmitted to the remote control receiving unit 207. When key data is inputted, the remote control receiving unit 207 outputs an instruction corresponding to the key data to the system control unit 208. On receiving this instruction, the system control unit 208 has the valid function determining unit 76 determine whether the indicated function is permitted for the title presently being reproduced, based on the flags showing the structural characteristics of the reproduction route of the title and the flags showing the functional characteristics of the reproduction route of the title. More specifically, the chapter search function, the time search function, and the chapter programming reproduction function are permitted when the single sequential PGC identification flag and the no automatic

branch flag are set, while the inter-title programming reproduction function is permitted when the single sequential PGC identification flag and the no inter-title branch flag are set, with various predetermined control operations being performed in the respective cases. When the execution of an indicated function is prohibited by the valid function determining unit 76, the instruction inputted in accordance with the user's key data is ignored.

[0099]

With the multimedia optical disc and reproduction apparatus of the present embodiment, when an application is being reproduced, the reproduction apparatus can quickly determine whether the execution of functions, such as feedback functions for the chapter number and reproduction expired time, search functions for an indicated chapter number or reproduction expired time, and programmed reproduction functions for chapter numbers or title numbers, is possible, and can prohibit functions which are not possible to avoid erroneous operation.

[0100]

Fig. 15 shows the relationships between (1) states of the single sequential PGC identification flag and no automatic branch flag with their accompanying title characteristics and (2) information showing whether AV disc functions, such as chapter display, reproduction expired time display, a chapter search function, a time search

function, and a chapter programming reproduction function, are permitted.

[0101]

Fig. 16 shows the relationships between (1) states of the single sequential PGC identification flag and no inter-title branch flag with their accompanying title characteristics and (2) information showing whether AV disc functions are permitted.

[0102]

In the present embodiment, feedback information such as the chapter number and reproduction expired time can be displayed during the reproduction of a title. By doing so, the user can comprehend the correspondence between this feedback information and the content of the reproduced data. As a result, when reproduction is complete, the user is able to perform search operations based on chapter number or reproduction expired time having inputted the correct title number, which helps the user avoid erroneous operation.

[0103]

It should be noted here that in the present embodiment, the structural characteristics of the reproduction route of the title were expressed using the single sequential PGC identification flag with the functional characteristics of the title being expressed by the no automatic branch flag and the no inter-title branch flag, although other flags may be used, so long as they

represent the structural and functional characteristics of the reproduction route of the title. As one example, a "Multi-PGC" flag and a flag which guarantees that the route is sequential may be used to show the structural characteristics, while a branch-present flag, a no branch flag, and flags which show the presence/absence of various commands, such as timer functions, may be used to show the functional characteristics of the reproduction route. In the same way, the function permission judging table need not judge whether functions can be performed by looking at the combinations of structural characteristics and functional characteristics of the reproduction route of the title. As examples, a sequential PGC identification flag and a no automatic branch flag may be provided, with the chapter search function and reproduction expired time display function being executable when both these flags are ON, so that even when a route is made up of a plurality of PGCs, these functions will still be possible provided that the PGCs are sequential.

[0104]

It should be noted here that the condition in the present embodiment for the no automatic branch flag to be ON was described as the lack of cell commands in the PGC which forms the title, although provided the commands are automatically executed and are present inside the PGC, the condition may be set as the absence of branch instructions

in buttons which have a default execution attribute, meaning they are executed when there is no user interaction, as the attribute in the highlight information stored in the MPEG stream.

[0105]

The condition for the setting of the no inter-title branch flag at ON has also been described as the absence of branch commands which switch titles, although it may still be set at ON when such branch commands are present as button instructions executed as a result of user interaction. In such case, even if the title includes manual branches to other titles, the no inter-title branch flag is set at ON, so that if the single sequential PGC identification flag is ON, the inter-title programming function is permitted. However, in this case, when a button which executes a branch to another title is selected by the user during the execution of the inter-title programming function, inconsistencies will arise in the execution order of titles registered in the inter-title programming reproduction, so that the reproduction apparatus will need to execute a process invalidating the inter-title programming.

[0106]

Effect of the Invention

With the invention of Claim 1, a multimedia optical disc is achieved where the determination of whether AV disc functions are possible can be performed by recording flags

which show the structural characteristics of titles and flags which show the functional characteristics of titles.

[0107]

With the invention of Claim 4, the reproduction apparatus includes first flag storage means for storing the first flag information for the title being reproduced, and second flag storage means for storing the second flag information for the title being reproduced. The reproduction apparatus also has a control means which judges whether AV disc functions are possible based on the function permission table information and the first and second flag information, and only performs functions whose execution is permitted. As a result, the reproduction apparatus does not have to trace reproduction routes and branch instructions one by one when there is function execution request, meaning that judging can be performed quickly, and that the execution of functions can be prevented when not appropriate.

[0108]

With the invention of Claim 2, a single sequential system stream control information flag is stored to show the structural characteristics and a no automatic branch flag is stored to show the functional characteristics of a title. As a result, titles which are made up of a single sequential PGC and which do not contain any automatic branches can be quickly identified.

[0109]

With the invention of Claim 5, the reproduction apparatus can judge whether the feedback function is permitted by looking at the single sequential PGC identification flag and the no automatic branch flag. As a result, the judgement of whether the feedback function is possible can be quickly performed and the execution of this function can be soon prohibited when inappropriate.

[0110]

With the invention of Claim 6, the reproduction apparatus can judge whether the search function is permitted by looking at the single sequential PGC identification flag and the no automatic branch flag. As a result, the judgement of whether the search function is possible can be very quickly performed and the execution of this function can be soon prohibited when inappropriate.

[0111]

With the invention of Claim 3, the single sequential PGC identification flag shows the structural characteristics of a title, while the no automatic branch flag and the no inter-title branch flag show the functional characteristics. As a result, titles which are made up of a single sequential PGC and which do not contain any automatic branches can be quickly identified, as can titles which are made up of a single sequential PGC and which do not contain any branches to other titles.

[0112]

With the invention of Claim 7, the settings of the single sequential PGC identification flag, the no automatic branch flag, and the no inter-title branch flag are used as the execution permission conditions, so that the reproduction apparatus can quickly judge whether the programming function and/or the title programming function are valid, with the execution of these functions being prohibited when not appropriate.

[0113]

With the invention of Claim 8, the reproduction apparatus is equipped with a state display unit for displaying a title number and an index number, so that the user will be able to grasp the reproduction expired time and chapter number for each title.

Simplified Explanation of the Drawings

Fig. 1 shows the cross-section of the DVD optical disc of the present embodiment.

Fig. 2A shows the data construction of the DVD optical disc of the present embodiment.

Fig. 2B shows the data construction of the DVD optical disc of the present embodiment.

Fig. 2C shows the data construction of the DVD optical disc of the present embodiment.

Fig. 3 shows the data construction of the video file management information of the video file in the present embodiment.

Fig. 4A shows the data construction of the video data in the video file of the present embodiment.

Fig. 4B shows the data construction of the video data in the video file of the present embodiment.

Fig. 5 shows the data construction of the video management file of the present embodiment.

Fig. 6 is a block diagram showing the entire construction of the reproduction apparatus of the present embodiment.

Fig. 7 is a block diagram of the construction of the system control unit in the present embodiment.

Fig. 8 shows the menu at the start of reproduction in the present embodiment.

Fig. 9 shows the key arrangement for the remote controller in the present embodiment.

Fig. 10A shows an application which has multiple reproduction routes.

Fig. 10B shows an application which has multiple reproduction routes.

Fig. 11 shows an application which has a single sequential reproduction route.

Fig. 12A is a drawing used for explaining the definition of a single sequential PGC.

Fig. 12B is a drawing used for explaining the definition of a single sequential PGC.

Fig. 12C is a drawing used for explaining the definition of a single sequential PGC.

Fig. 13A is a drawing used for explaining the concept of a branch from a PGC.

Fig. 13B is a drawing used for explaining the concept of a branch from a PGC.

Fig. 13C is a drawing used for explaining the concept of a branch from a PGC.

Fig. 14 shows the flag settings which are necessary for the execution of various functions.

Fig. 15 shows the relationship of the single sequential PGC identification flag and no automatic branch flag with the characteristics of a title.

Fig. 16 shows the relationship of the single sequential PGC identification flag and no inter-title branch flag with the characteristics of a title.

Numerical References

200 ... optical disc

201 ... motor

202 ... optical pickup

203 ... mechanism control unit

204 ... signal processing unit

205 ... AV decoding unit

2051 .. system decoder

2052 .. video decoder

2053 .. sub-picture decoder

2054 .. audio decoder

2055 .. image mixing unit

206 ... remote controller

207 ... remote control receiving unit

208 ... system control unit

209 ... state display unit

71 ... remote control input interpreting unit

72 ... reproduction control unit

73 ... button control unit

74 ... command interpreting/executing unit

75 ... system state management unit

76 ... valid function determining unit

107 ... DVD

108 ... first transparent substrate

109 ... information layer

110 ... bonding layer

111 ... second transparent substrate

112 ... print layer

113 ... light beam

114 ... light spot

Abstract of the Disclosure

Object

To quickly judge whether the execution of functions is possible for a movie application during reproduction, and to prevent execution when not possible, thereby preventing erroneous operation.

Construction

An optical disc which has at least one information layer between two transparent substrates which are of a same thickness that is 0.6mm or below, with the following characteristics being provided:

a system stream recording area for storing system streams which include video information and reproduction control commands; and

a reproduction control information recording area storing a system stream reproduction order and a plurality of sets of system stream reproduction control information which show reproduction control commands which are automatically executed during reproduction, a first set of flag information which shows the connected relation construction of a title, and a second set of flag information showing the characteristics of reproduction control commands included in a title.

Fig. 1

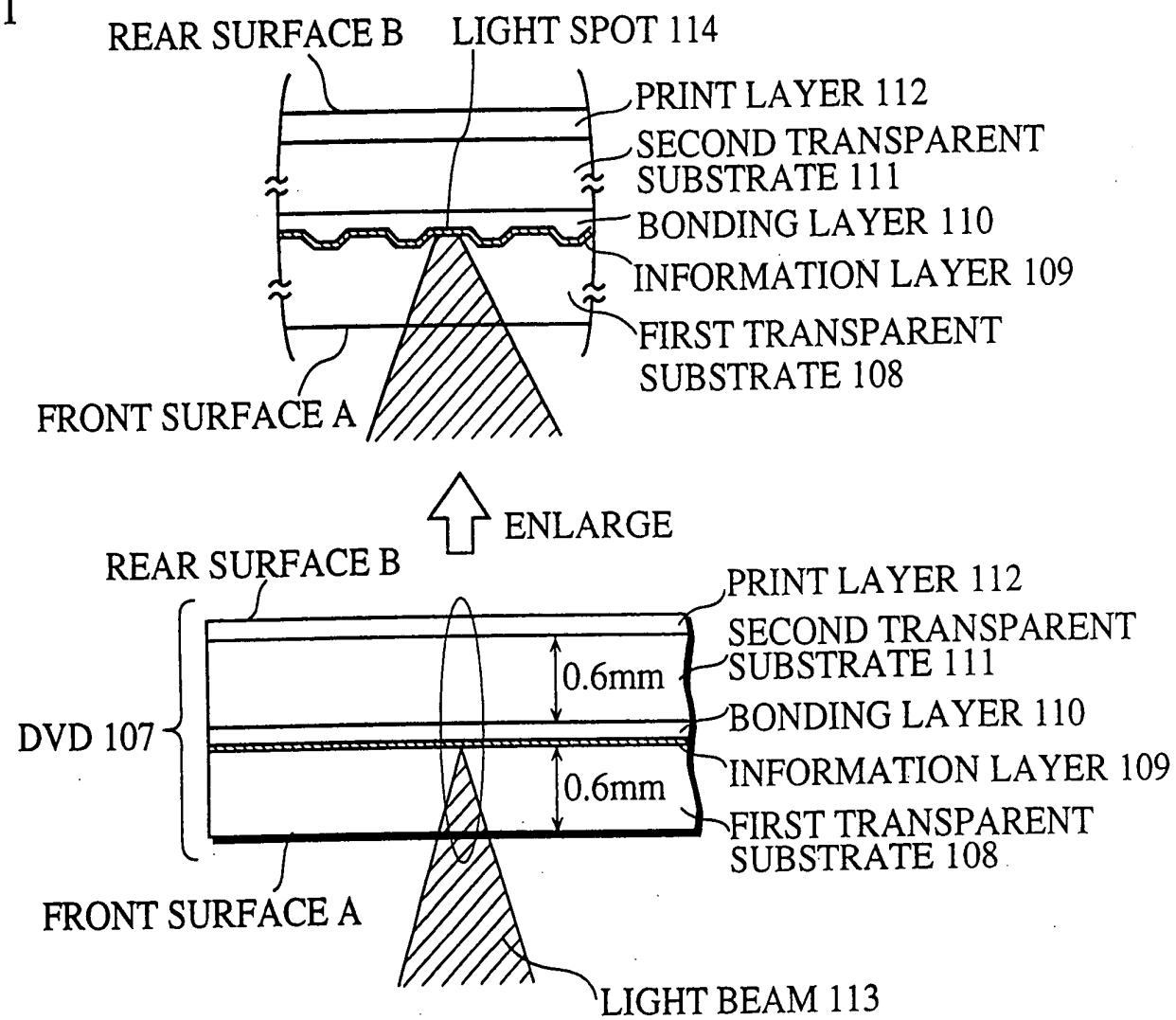

REAR SURFACE B
LIGHT SPOT 114
PRINT LAYER 112
SECOND TRANSPARENT SUBSTRATE 111
BONDING LAYER 110
INFORMATION LAYER 109
FIRST TRANSPARENT SUBSTRATE 108
FRONT SURFACE A
ENLARGE
REAR SURFACE B
PRINT LAYER 112
SECOND TRANSPARENT SUBSTRATE 111
0.6mm
BONDING LAYER 110
DVD 107
INFORMATION LAYER 109
0.6mm
FIRST TRANSPARENT SUBSTRATE 108
FRONT SURFACE A
LIGHT BEAM 113

Fig. 2A

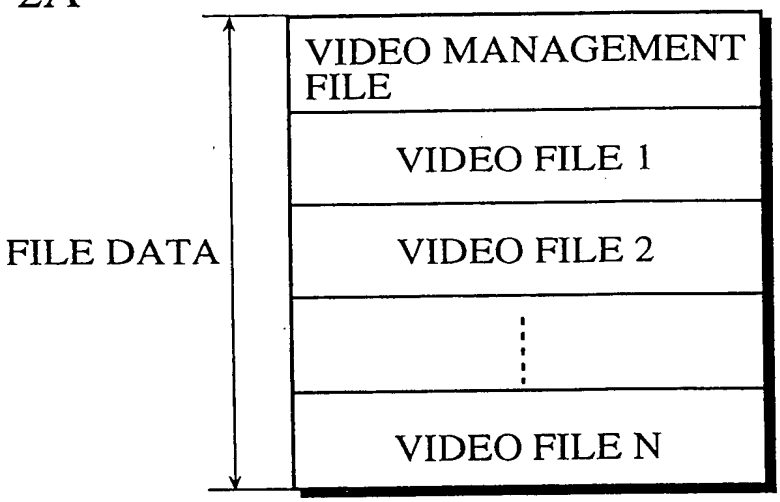


Fig. 2B

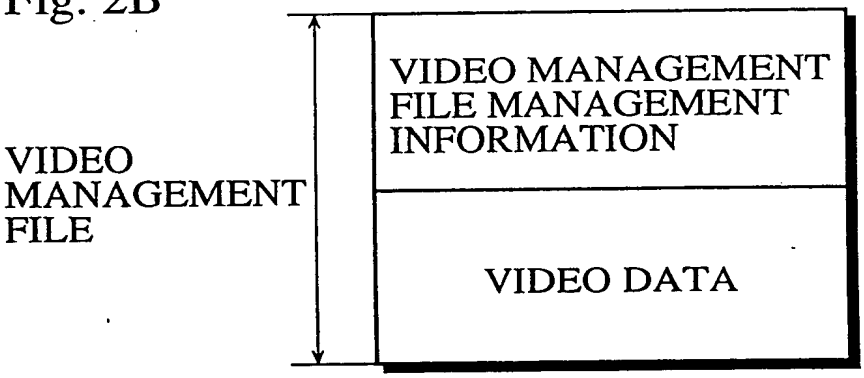


Fig. 2C

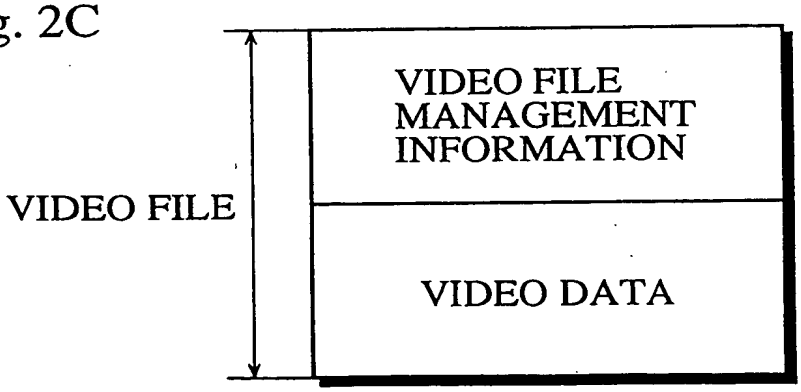


Fig. 3

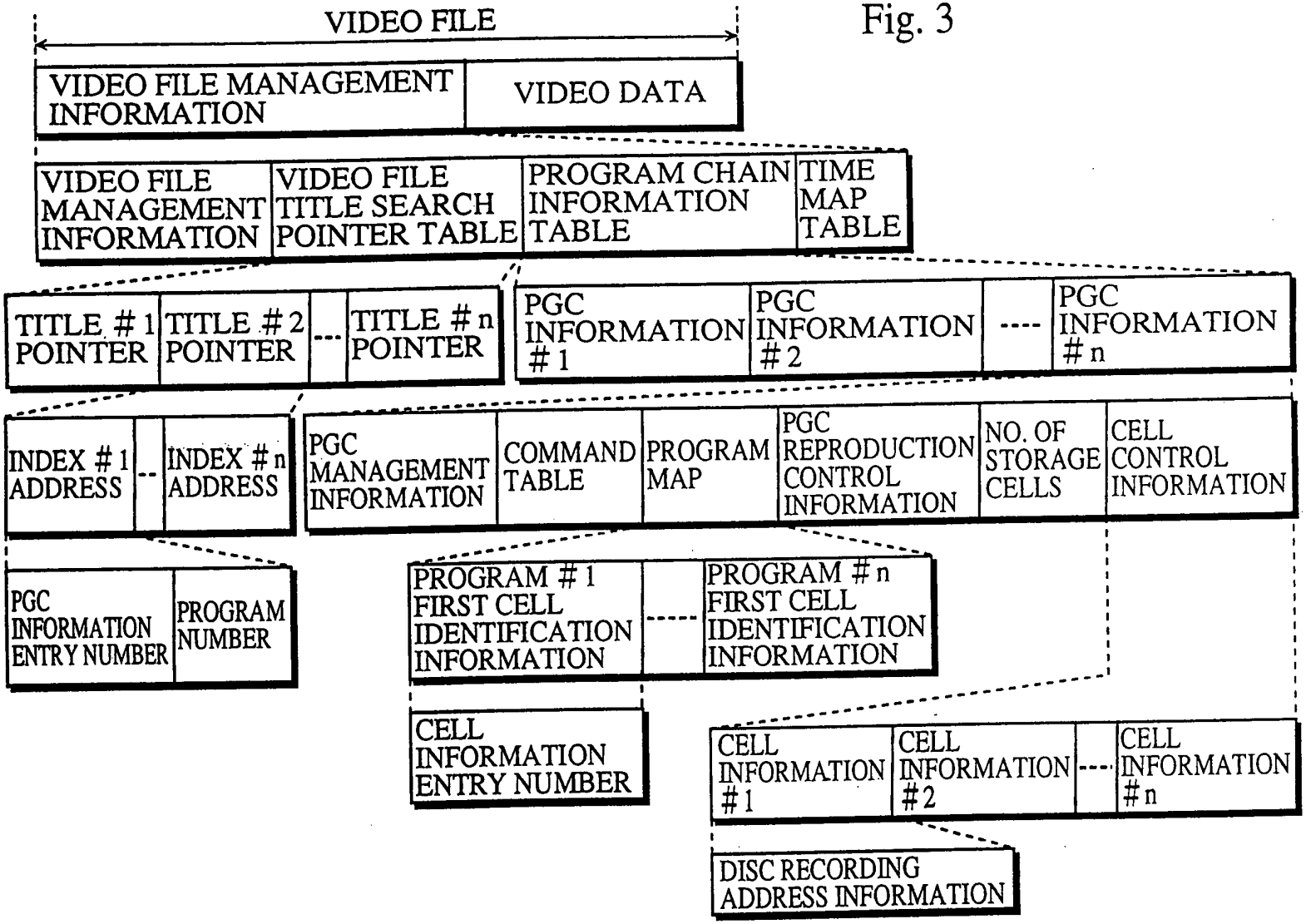

VIDEO FILE
VIDEO FILE MANAGEMENT INFORMATION
VIDEO DATA
VIDEO FILE MANAGEMENT INFORMATION
VIDEO FILE TITLE SEARCH POINTER TABLE
PROGRAM CHAIN INFORMATION TABLE
TIME MAP TABLE
TITLE #1 POINTER
TITLE #2 POINTER
TITLE #n POINTER
PGC INFORMATION #1
PGC INFORMATION #2
PGC INFORMATION #n
INDEX #1 ADDRESS
INDEX #n ADDRESS
PGC MANAGEMENT INFORMATION
COMMAND TABLE
PROGRAM MAP
PGC REPRODUCTION CONTROL INFORMATION
NO. OF STORAGE CELLS
CELL CONTROL INFORMATION
PGC INFORMATION ENTRY NUMBER
PROGRAM NUMBER
PROGRAM #1 FIRST CELL IDENTIFICATION INFORMATION
PROGRAM #n FIRST CELL IDENTIFICATION INFORMATION
CELL INFORMATION ENTRY NUMBER
CELL INFORMATION #1
CELL INFORMATION #2
CELL INFORMATION #n
DISC RECORDING ADDRESS INFORMATION

Fig. 4A

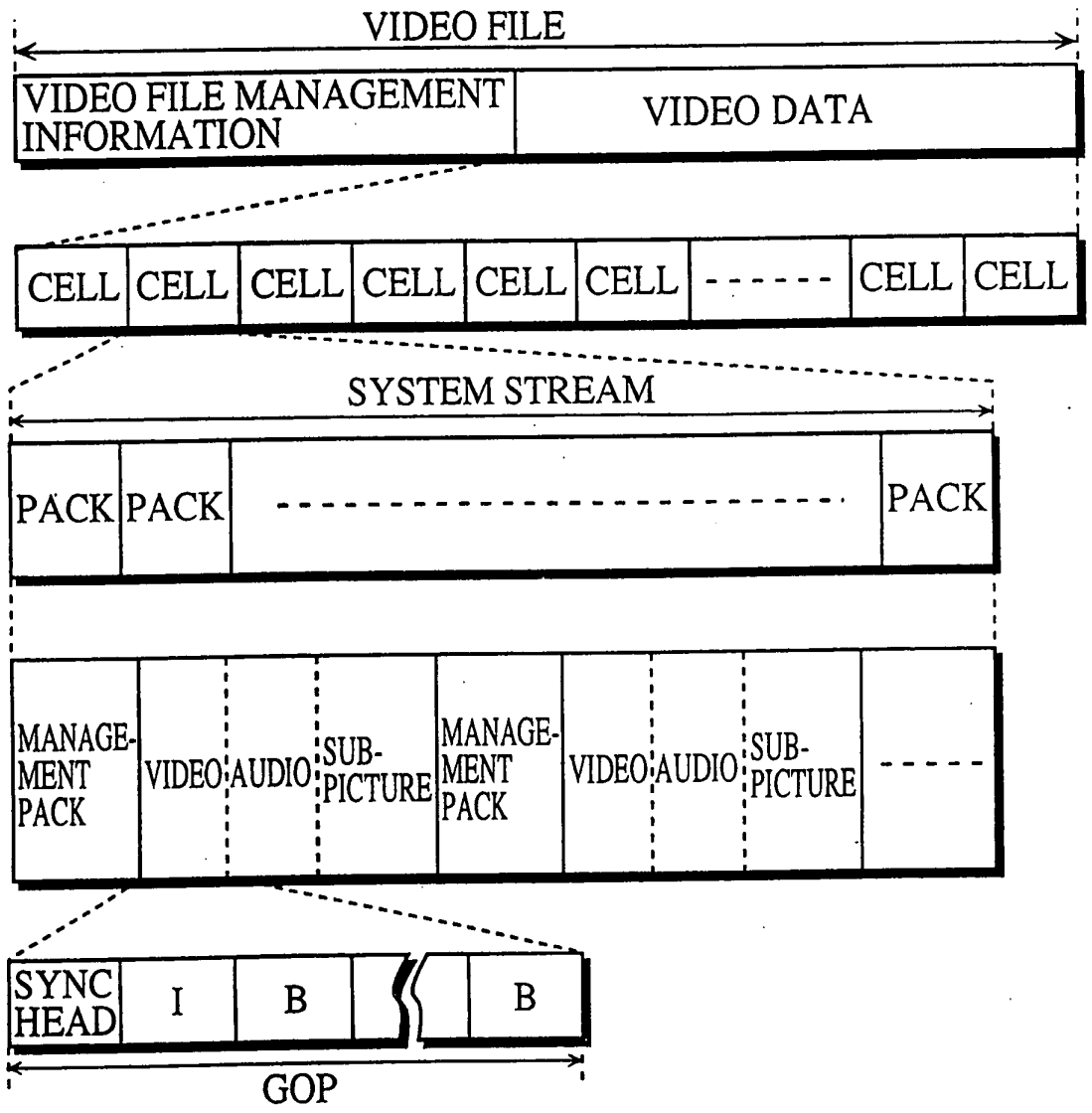
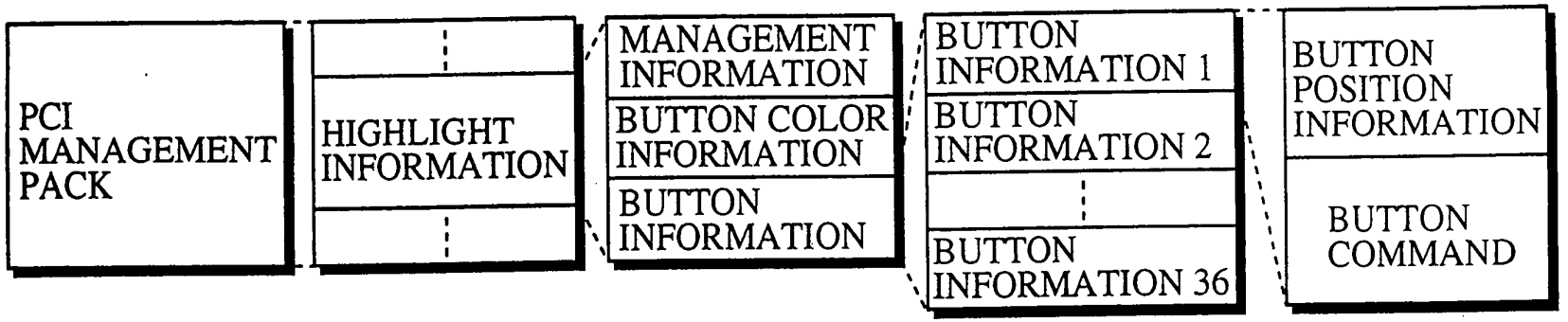

VIDEO FILE
VIDEO FILE MANAGEMENT INFORMATION
VIDEO DATA
CELL
CELL
CELL
CELL
CELL
CELL
CELL
CELL
SYSTEM STREAM
PACK
PACK
PACK
MANAGE-MENT PACK
VIDEO
AUDIO
SUB-PICTURE
MANAGE-MENT PACK
VIDEO
AUDIO
SUB-PICTURE
SYNC HEAD
I
B
B
GOP

FIG. 4B


PCI MANAGEMENT PACK
HIGHLIGHT INFORMATION
MANAGEMENT INFORMATION
BUTTON COLOR INFORMATION
BUTTON INFORMATION
BUTTON INFORMATION 1
BUTTON INFORMATION 2
BUTTON INFORMATION 36
BUTTON POSITION INFORMATION
BUTTON COMMAND

EP97015 EPC 修正9

Fig. 5

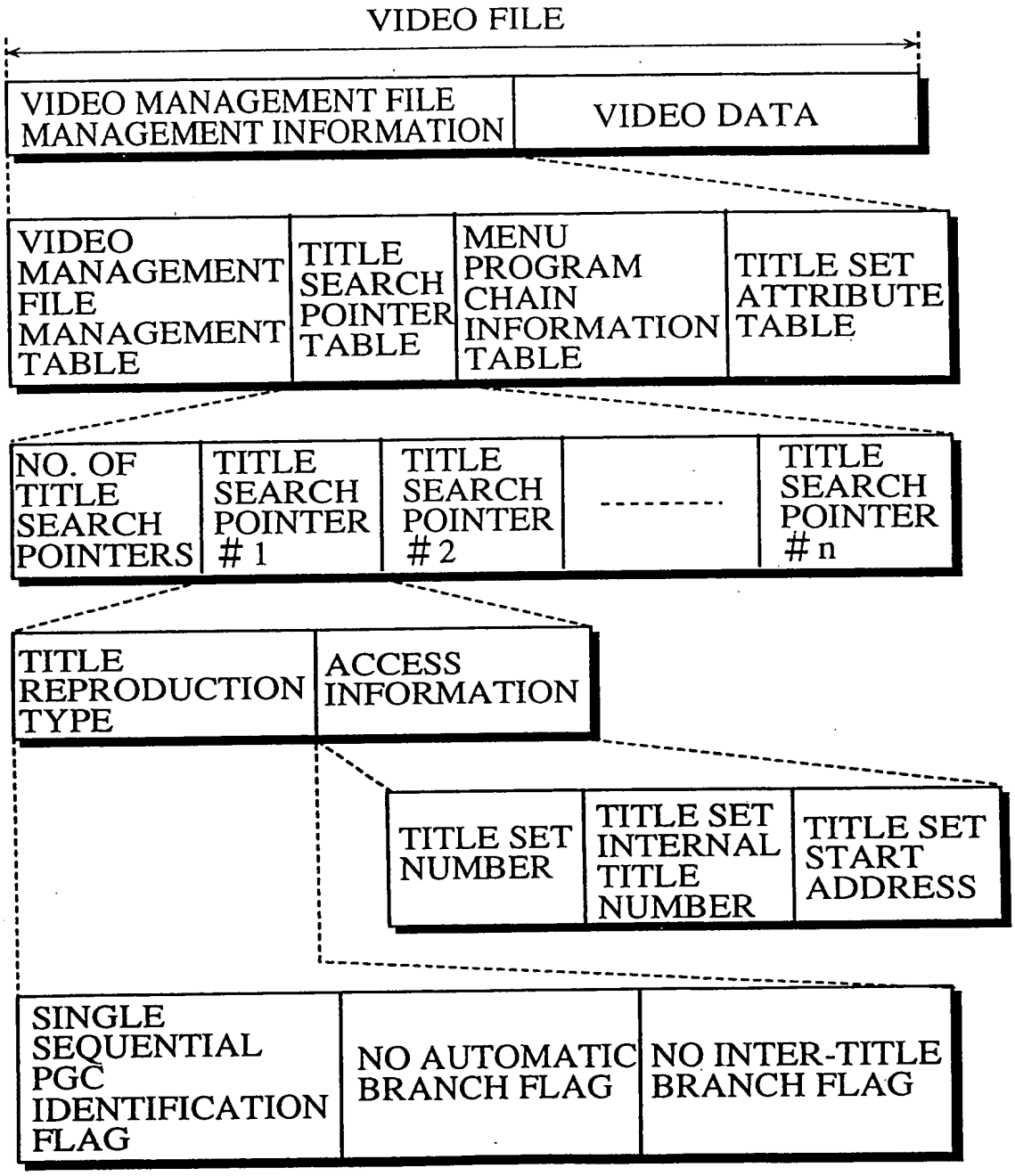


FIG. 6

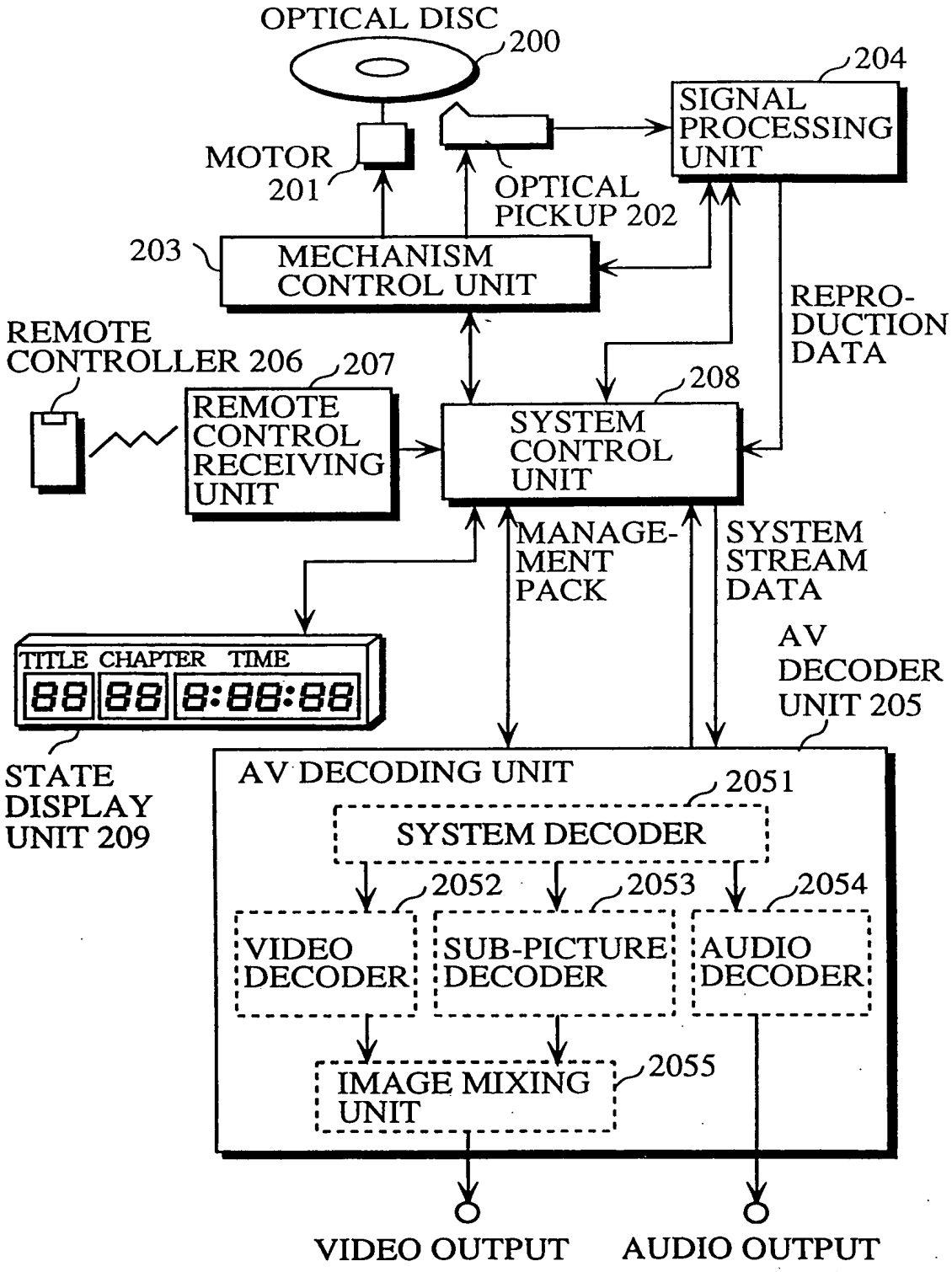

OPTICAL DISC
200
204
SIGNAL PROCESSING UNIT
MOTOR 201
OPTICAL PICKUP 202
203
MECHANISM CONTROL UNIT
REPRO-DUCTION DATA
REMOTE CONTROLLER 206
207
REMOTE CONTROL RECEIVING UNIT
208
SYSTEM CONTROL UNIT
MANAGE-MENT PACK
SYSTEM STREAM DATA
AV DECODER UNIT 205
TITLE CHAPTER TIME
88 88 8:88:88
STATE DISPLAY UNIT 209
AV DECODING UNIT
2051
SYSTEM DECODER
2052
2053
2054
VIDEO DECODER
SUB-PICTURE DECODER
AUDIO DECODER
IMAGE MIXING UNIT
2055
VIDEO OUTPUT
AUDIO OUTPUT

Fig. 7

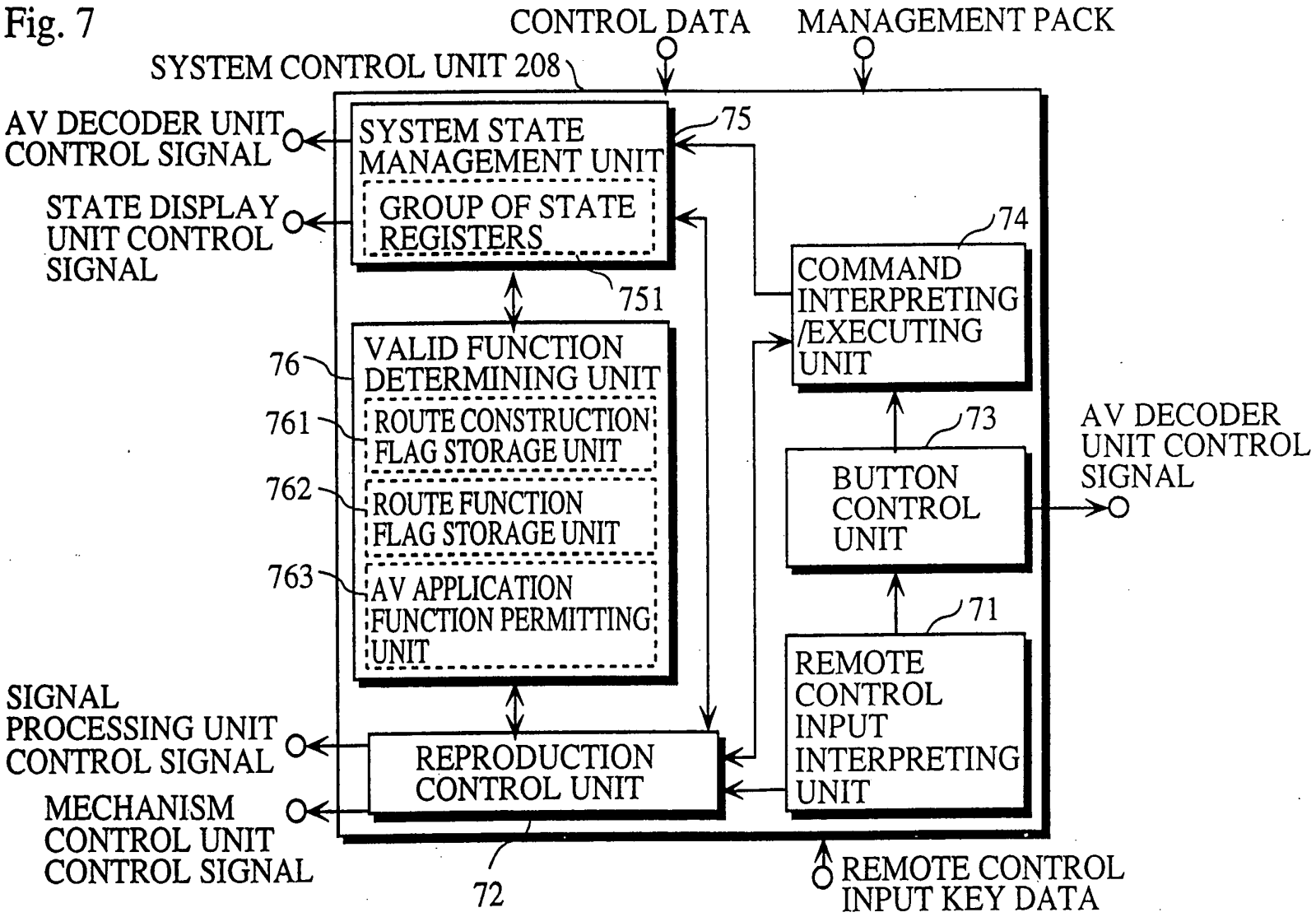

CONTROL DATA
MANAGEMENT PACK
SYSTEM CONTROL UNIT 208
AV DECODER UNIT CONTROL SIGNAL
STATE DISPLAY UNIT CONTROL SIGNAL
SYSTEM STATE MANAGEMENT UNIT
GROUP OF STATE REGISTERS
75
751
74
COMMAND INTERPRETING /EXECUTING UNIT
76
VALID FUNCTION DETERMINING UNIT
761
ROUTE CONSTRUCTION FLAG STORAGE UNIT
762
ROUTE FUNCTION FLAG STORAGE UNIT
763
AV APPLICATION FUNCTION PERMITTING UNIT
73
BUTTON CONTROL UNIT
AV DECODER UNIT CONTROL SIGNAL
71
REMOTE CONTROL INPUT INTERPRETING UNIT
SIGNAL PROCESSING UNIT CONTROL SIGNAL
MECHANISM CONTROL UNIT CONTROL SIGNAL
REPRODUCTION CONTROL UNIT
72
REMOTE CONTROL INPUT KEY DATA

Fig. 8

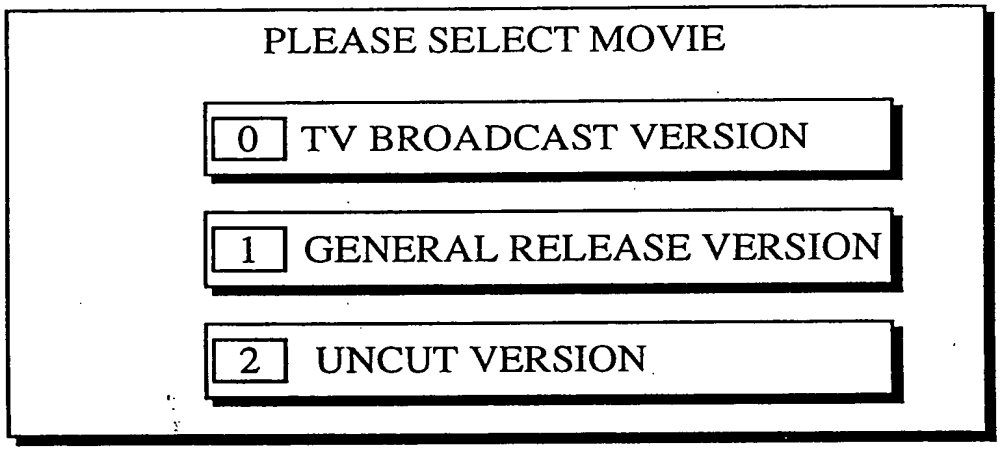

PLEASE SELECT MOVIE
0 TV BROADCAST VERSION
1 GENERAL RELEASE VERSION
2 UNCUT VERSION

Fig. 9

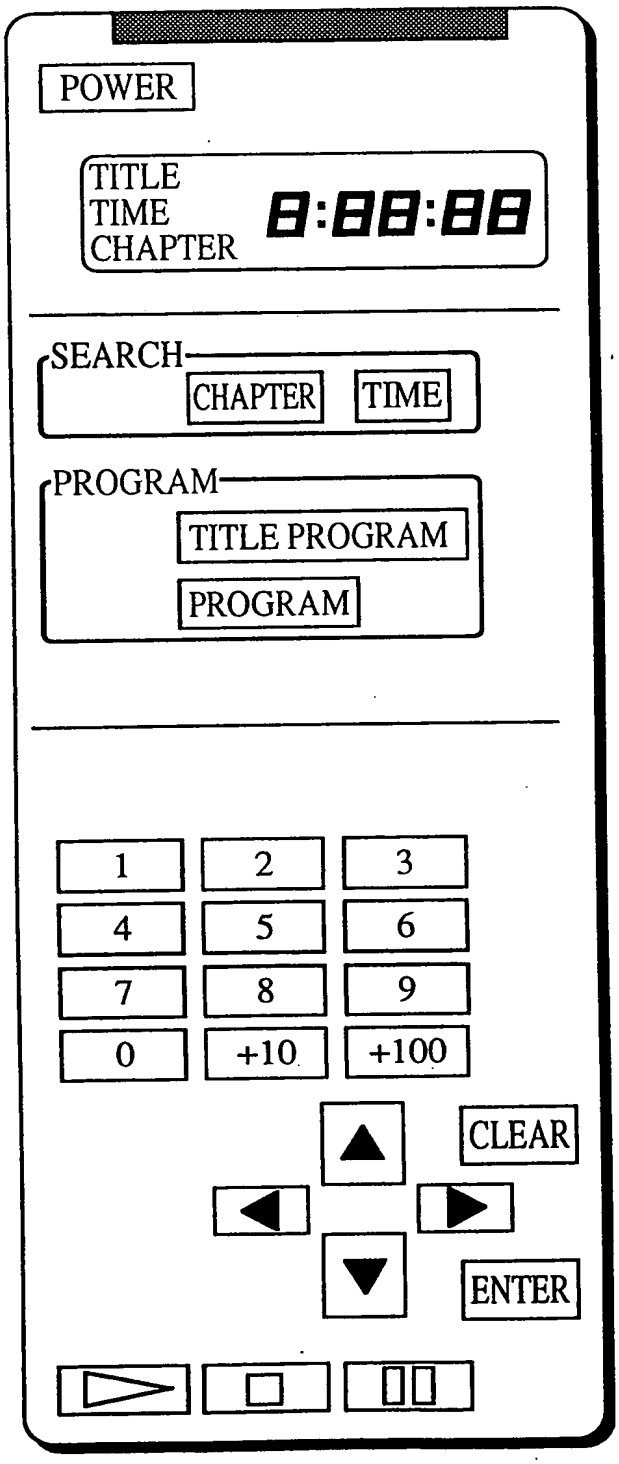

POWER
TITLE
TIME
CHAPTER
0:00:00
SEARCH
CHAPTER
TIME
PROGRAM
TITLE PROGRAM
PROGRAM
1
2
3
4
5
6
7
8
9
0
+10
+100
CLEAR
ENTER

Fig. 10A

REPRODUCTION ROUTE 1 : DETAILED EXPLANATION ——→
REPRODUCTION ROUTE 2 : SIMPLIFIED EXPLANATION - - - - →

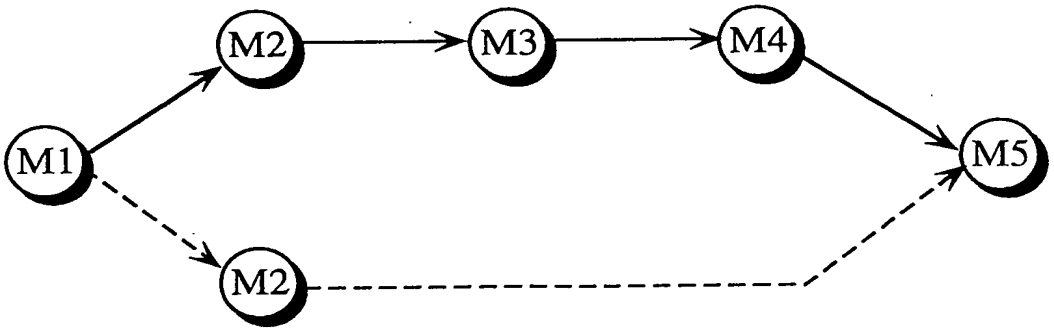


Fig. 10B

MOVIE	CONTENT
M1	ITEMS FOR SELECTING DETAILED EXPLANATION OR SIMPLIFIED EXPLANATION
M2	OUTLINE
M3	TOURIST SPOT INFORMATION
M4	GOURMET INFORMATION
M5	TRAFFIC INFORMATION

Fig. 11

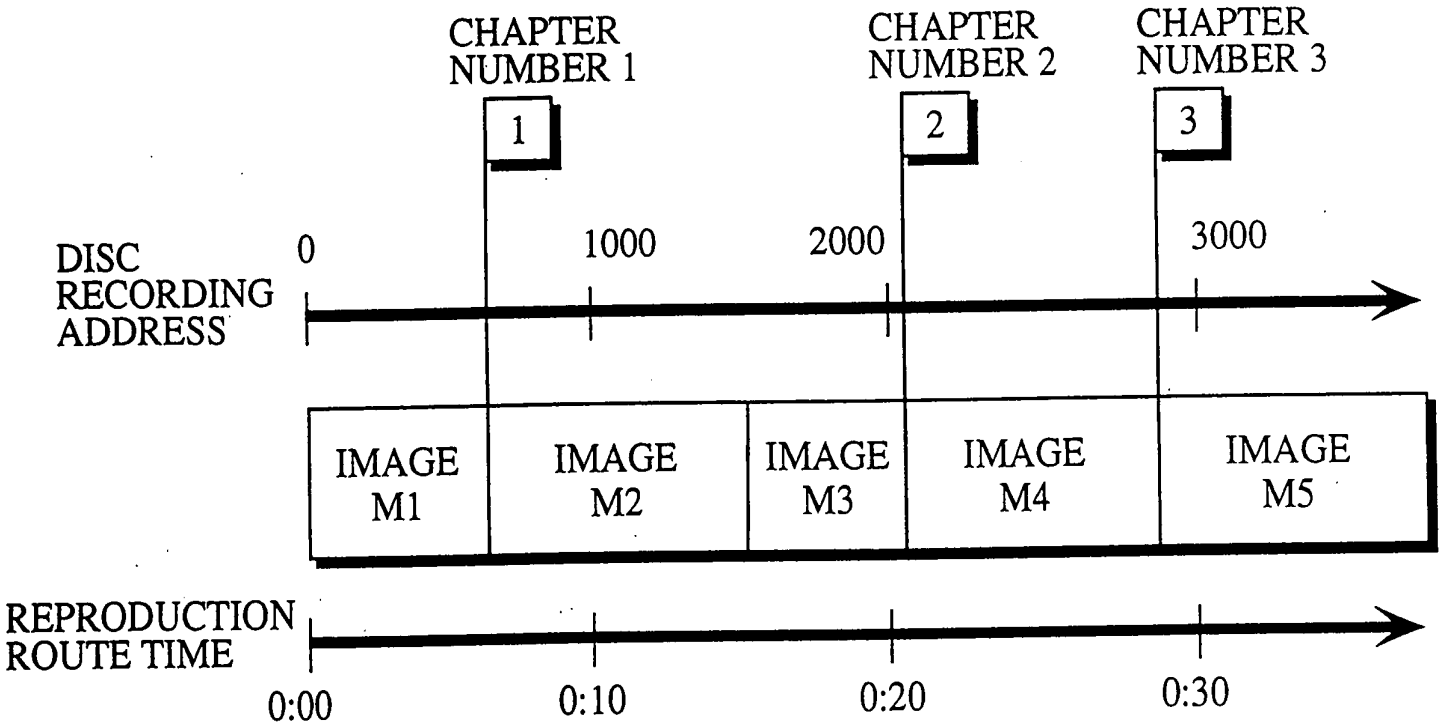

CHAPTER NUMBER 1
CHAPTER NUMBER 2
CHAPTER NUMBER 3
1
2
3
DISC RECORDING ADDRESS
0
1000
2000
3000
IMAGE M1
IMAGE M2
IMAGE M3
IMAGE M4
IMAGE M5
REPRODUCTION ROUTE TIME
0:00
0:10
0:20
0:30

Fig. 12A

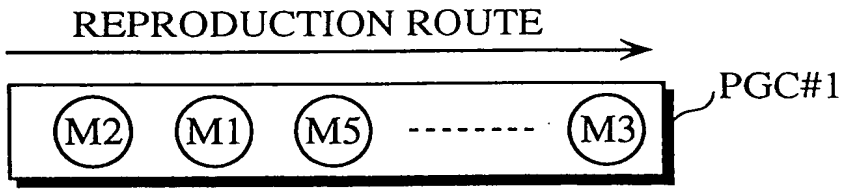


Fig. 12B

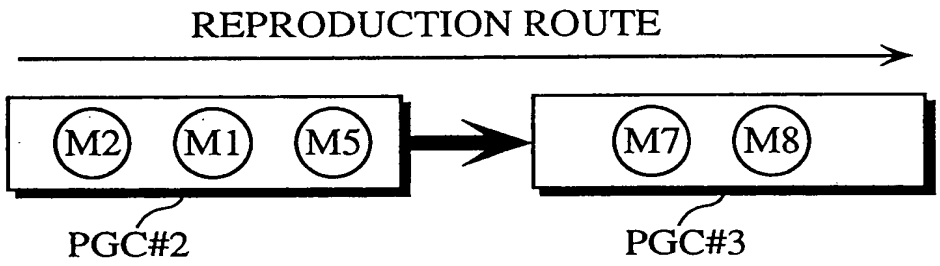


Fig. 12C

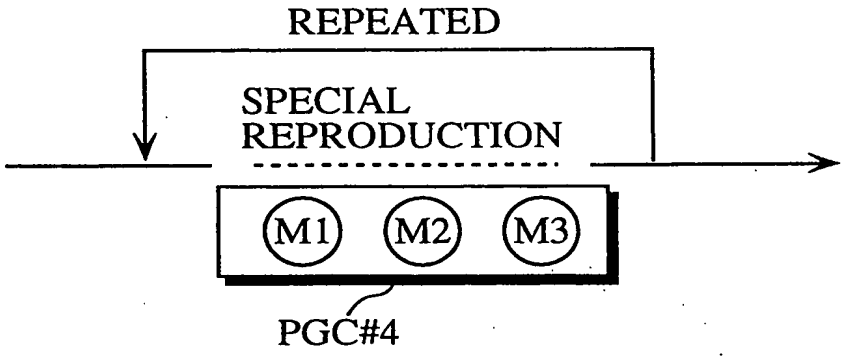


Fig. 13A

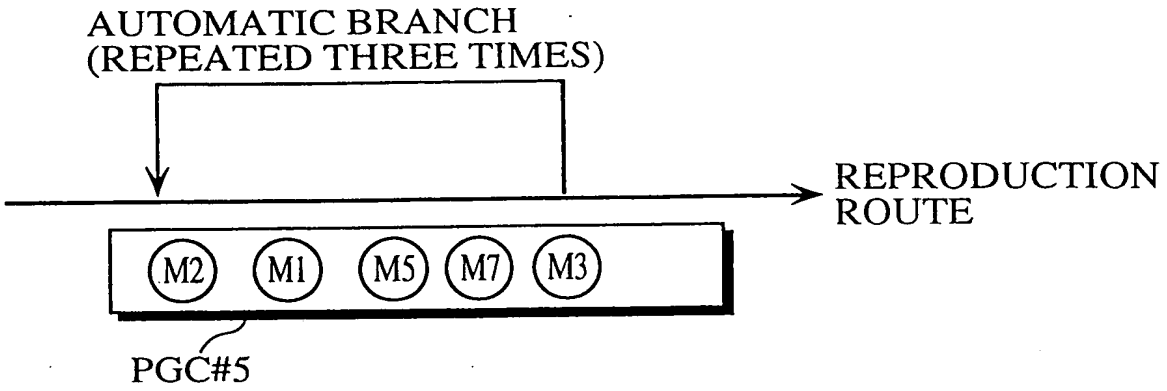


Fig. 13B

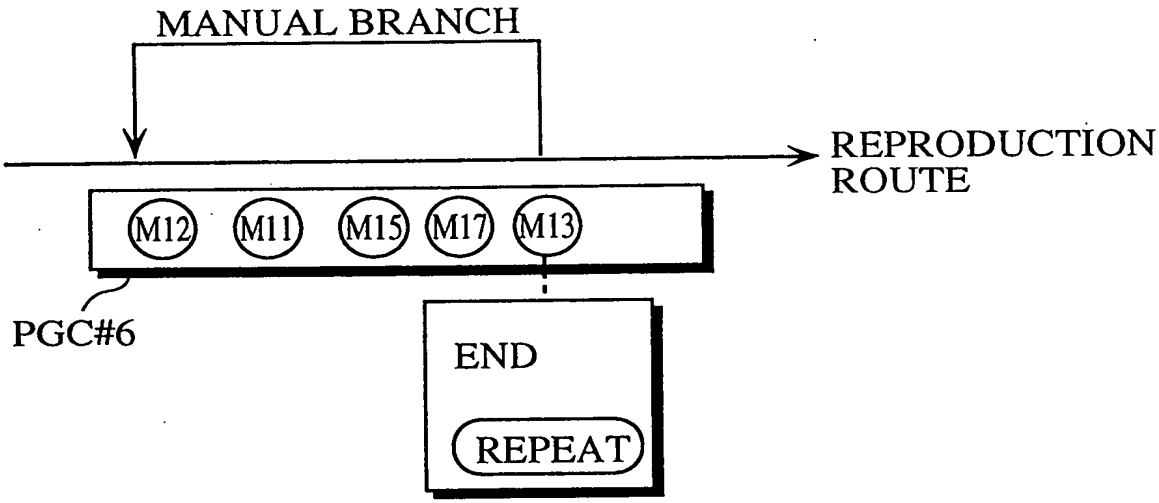


Fig. 13C

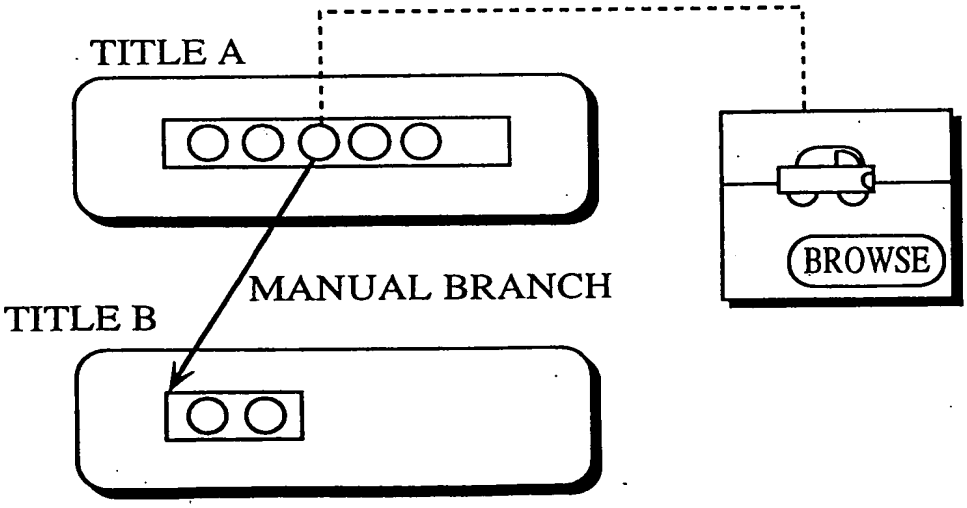


Fig. 14

FUNCTION	PERMISSION CONDITIONS		
	SINGLE SEQUENTIAL PGC FLAG	NO AUTOMATIC BRANCH FLAG	NO INTER-TITLE BRANCH FLAG
CHAPTER NUMBER DISPLAY	ON	ON	—
REPRODUCTION ROUTE EXPIRED TIME DISPLAY	ON	ON	—
CHAPTER NUMBER SEARCH	ON	ON	—
TIME SEARCH	ON	ON	—
TITLE INTERNAL PROGRAM REPRODUCTION	ON	ON	—
INTER-TITLE PROGRAM REPRODUCTION	ON	—	ON

Fig. 15

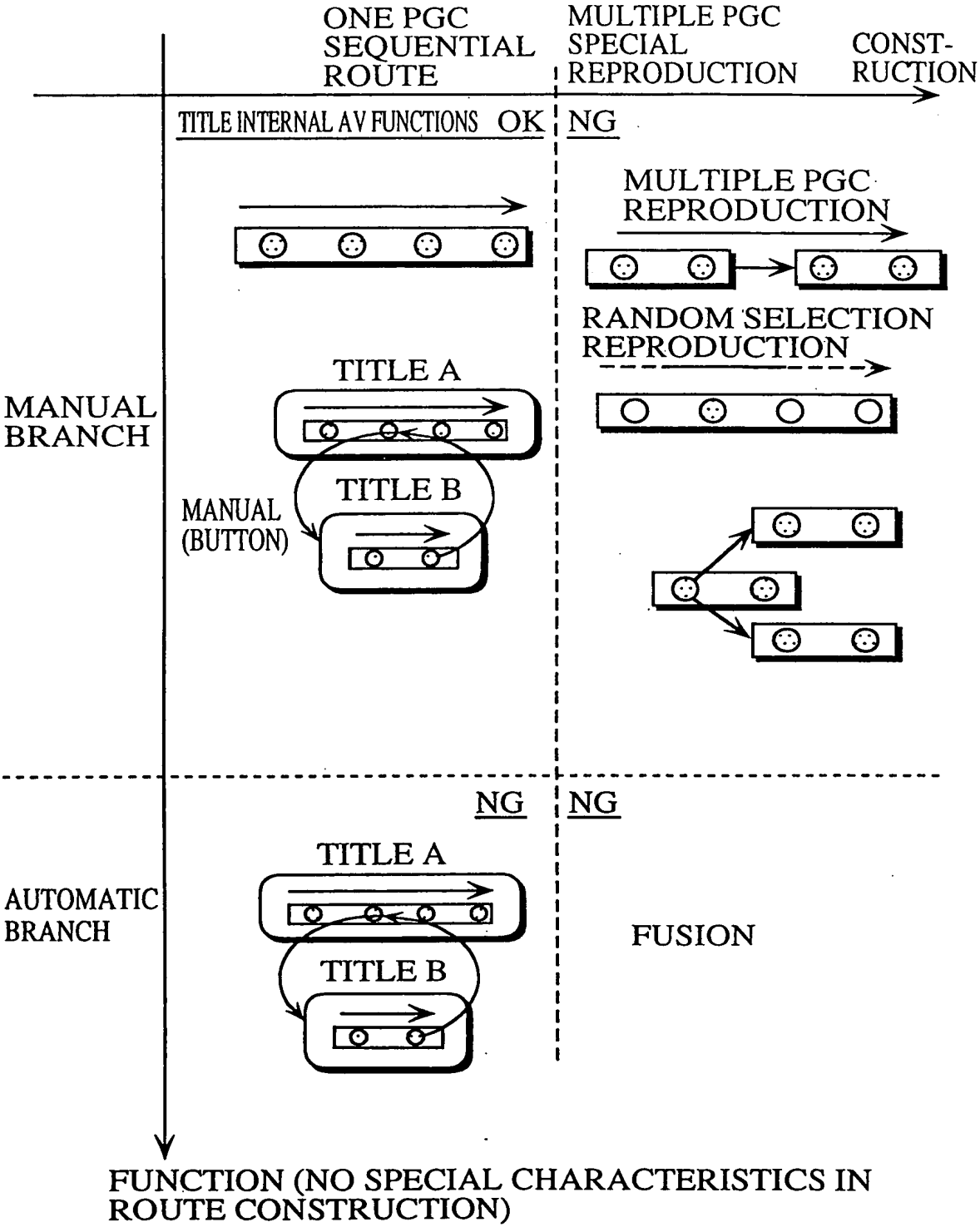
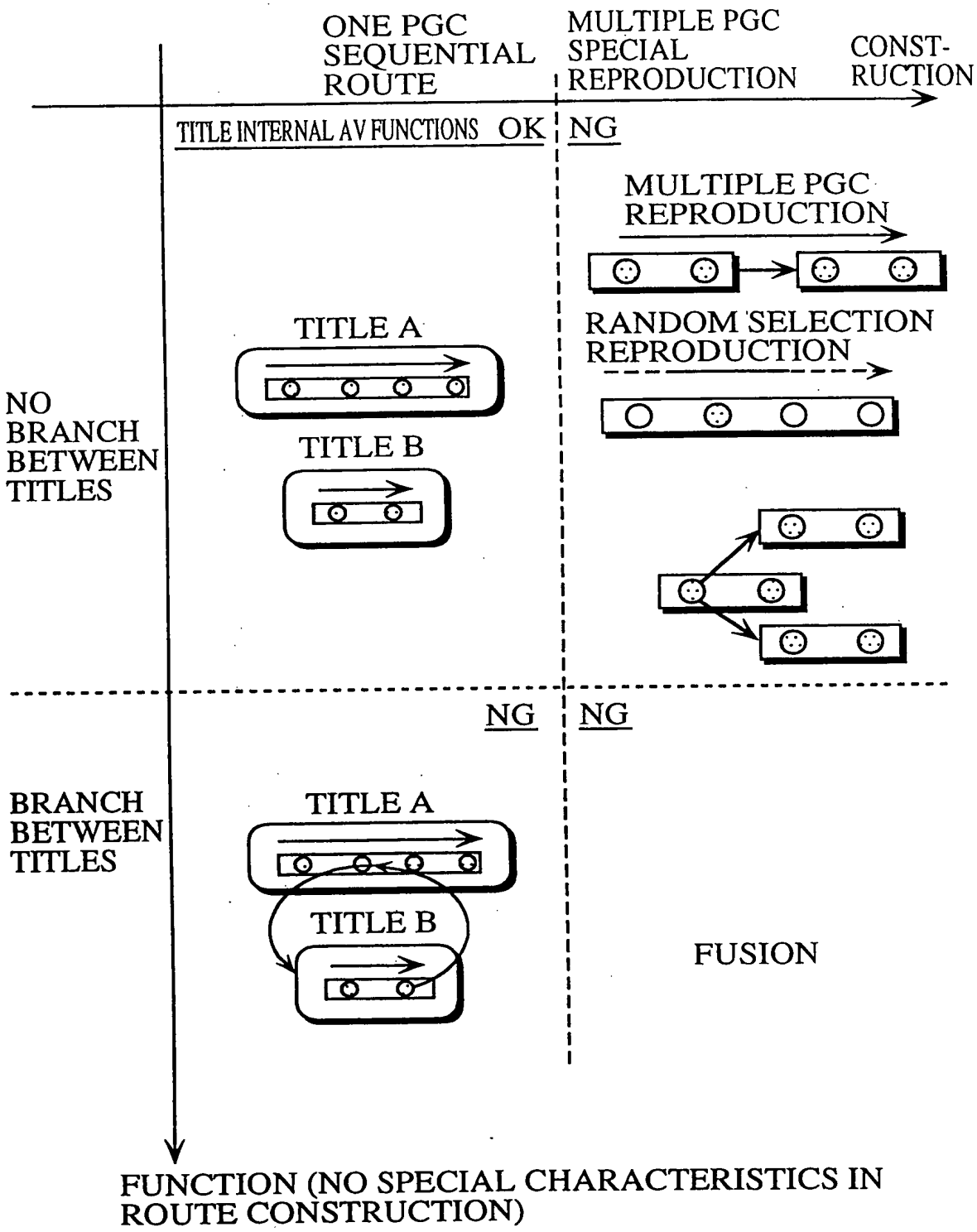

ONE PGC SEQUENTIAL ROUTE
MULTIPLE PGC SPECIAL REPRODUCTION
CONST-RUCTION
TITLE INTERNAL AV FUNCTIONS OK
NG
MULTIPLE PGC REPRODUCTION
RANDOM SELECTION REPRODUCTION
TITLE A
MANUAL BRANCH
TITLE B
MANUAL (BUTTON)
NG
NG
TITLE A
AUTOMATIC BRANCH
TITLE B
FUSION
FUNCTION (NO SPECIAL CHARACTERISTICS IN ROUTE CONSTRUCTION)

Fig. 16


ONE PGC SEQUENTIAL ROUTE
MULTIPLE PGC SPECIAL REPRODUCTION
CONST-RUCTION
TITLE INTERNAL AV FUNCTIONS OK
NG
MULTIPLE PGC REPRODUCTION
TITLE A
RANDOM SELECTION REPRODUCTION
NO BRANCH BETWEEN TITLES
TITLE B
NG
NG
BRANCH BETWEEN TITLES
TITLE A
TITLE B
FUSION
FUNCTION (NO SPECIAL CHARACTERISTICS IN ROUTE CONSTRUCTION)